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VOC (Volatile Organic Compounds) Emissions from Volatile Organic Liquid Storage Tanks-Background Information for Promulgated Standards

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Research Triangle Park, NC

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Standards of Performance for the control of VOC emissions from Volatile Organic Liquid (VOL) storage tanks are being promulgated under the authority of Section 111 of the Clean Air Act. These standards would apply to all new and existing storage tanks having a capacity of 75 cubic meters or larger, which are to be used for the storage of VOL. This document contains a summary of the public comments on the proposed revised standards and the EPA's responses, as well as summary economic and environmental impact statements.

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Final EIS

Background Information for Promulgated Standards

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VOC Emissions from Volatile Organic Liquid Storage Tanks — Background Information for Promulgated Standards

Emission Standards and Engineering Division

U.S. Environmental Protection Agency
Office of Air and Radiation
Office of Air Quality Planning and Standards
Research Triangle Park NC 27711

January 1987

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ENVIRONMENTAL PROTECTION AGENCY
Background Information
and Final
Environmental Impact Statement for
VOC Emissions from Volatile Organic Liquid Storage Tanks

Prepared by:

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4/8/87
(Date)

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1. The promulgated standards of performance would limit emissions of volatile organic compounds (VOC) from new, modified, and reconstructed VOL storage vessels. Section 111 of the Clean Air Act (42 U.S.C. 7441), as amended, directs the Administrator to establish standards of performance for any category of new stationary source of air pollution that". . . causes or contributes significantly to air pollution which may reasonably be anticipated to endanger public health or welfare".

2. Copies of this document have been sent to the following Federal Departments: Labor, Defense, Transportation, Commerce, Interior, and Energy; the Council on Environmental Quality; members of the State and Territorial Air Pollution Program Administrators; the Association of Local Air Pollution Control Officials; EPA Regional Administrators; and other interested parties.

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1. SUMMARY

On July 23, 1984, the Environmental Protection Agency (EPA) proposed standards of performance for volatile organic liquid (VOL) storage vessels (including petroleum liquid storage vessels) (49 FR 29698) under authority of Section 111 of the Clean Air Act. Public comments were requested in the proposal in the Federal Register. A total of 15 comments from industry, 6 from trade associations, and 3 from governmental agencies were submitted during the comment period. The comments that were submitted, along with responses to these comments, are summarized in this document. The summary of comments and responses serves as the basis for the revisions made to the standards between proposal and promulgation.

1.1 SUMMARY OF CHANGES SINCE PROPOSAL

In response to public comments, certain changes have been made in the proposed standards. The more significant changes are summarized below. All changes that have been made to the regulation are explained fully in the responses to comments.

The Agency has reevaluated the vapor pressure cutoff. For storage vessels with a capacity greater than or equal to 151 m^3 (≈40,000 gal), the vapor pressure cutoff has been revised from "greater than or equal to 3.5 kPa (≈0.51 psia)" to "greater than or equal to 5.2 kPa (≈0.75 psia)."

Three specific exemptions to the standards were made in response to requests from commenters. An exemption was added for storage vessels at retail gasoline service stations. The EPA did not intend to affect vessels at gasoline service stations with these standards. Consequently, no evaluation of the possible economic impact of these standards on retail gasoline marketers was performed. An exemption was also made for bulk gasoline plants. These plants have been identified as small businesses, and there is a potential for the impact of the standards to

result in an adverse economic impact on bulk plants. Storage vessels at gasoline service stations and bulk plants are part of a separate source category, and the decision as to whether to regulate emissions from these vessels is being made in a regulatory decision package for that category. Refer to Section 2.1.3.1, Horizontal and Underground Vessels, and Section 2.1.3.7, Bulk Plant Storage Vessels, for further explanation of the changes.

Facilities producing beverage alcohol have been excluded from the standards because they have been previously exempted from the priority list as part of a source category. Refer to Section 2.1.3.2, Facilities Producing Beverage Alcohol, for further discussion of the change.

Two changes were made to the control technology requirement. The major change is that the best demonstrated technology (BDT) for column fittings has been expanded to allow the use of gasketed sliding covers in addition to flexible fabric sleeve seals. The Agency determined that the requirement for flexible fabric sleeve seals in the proposed standards was unduely restrictive because these seals are not presently available on noncontact decks. Refer to Section 2.2.4, Column Fittings, for further discussion of the change.

The other change to the control technology requirements is a revision to the flare exit velocity limitations. A recently completed EPA test program has shown that flares can efficiently remove volatile organic compounds (VOC's) at higher exit velocities when the net heating value of the gas being combusted is high. Refer to Section 2.2.3, Add-on Control Options, for further explanation of the change.

Two major changes were made to the monitoring requirements. Vessels classified as "waste" tanks are subject to revised vapor pressure monitoring requirements based on semiannual physical testing rather than frequent (perhaps daily) determinations to estimate the vapor pressure of a waste mixture of indeterminate or variable composition. Refer to Section 2.1.3.4, "Slop Oil," Wastewater, and Waxy, Heavy Crude Storage Vessels, for further explanation of the change.

The other major change has been made to the annual inspection requirement for internal floating roof seal systems. The Agency has determined that it may not be possible to inspect these vessels without

emptying and degassing the vessel. The inspection requirement has been revised to allow the owner or operator the option to equip the vessel with a primary and a secondary seal and conduct an internal inspection every 5 years. This option is considered equivalent to an annual visual inspection of a single-seal system. Refer to Section 2.3.3.1, Annual Visual Inspection, for further discussion.

1.2 SUMMARY OF IMPACTS OF PROMULGATED ACTION

1.2.1 Alternatives to Promulgated Action

The regulatory alternatives are discussed in Chapter 6 of the Volume I background information document (BID) for the proposed standards (EPA-450/3-81-003a). These regulatory alternatives reflect the different levels of emission control from which one that represents BDT is selected, considering costs, nonair quality health, and environmental and economic impacts for VOL storage vessels. Regulatory Alternative III has been revised to expand the options for fitting controls. As discussed in Section 1.1, the owner or operator has the option of installing gasketed sliding covers instead of flexible fabric sleeve seals.

1.2.2 Environmental Impacts of Promulgated Action

The environmental impacts are discussed in Chapter 7 and Appendix D of the Volume I BID. Data are not available to determine with precision the effects of changing the vapor pressure cutoff from 3.5 to 5.2 kPa (0.51 to 0.75 psia), but any effects would be relatively small or negligible. Therefore, the Volume I BID now becomes the final Environmental Impact Statement for the promulgated standards.

1.2.3 Energy and Economic Impacts of the Promulgated Action

The energy impacts of the proposed standards are evaluated in Chapter 7 of the Volume I BID. It was determined that the control technologies that are the bases for the regulatory alternatives do not increase the power or other energy requirements of VOL storage vessels. Therefore, no energy impacts are attributed to the proposed or final standards.

The economic impacts of the proposed standards are evaluated in Chapter 9 of the Volume I BID. Since proposal, the cost of the liquid-mounted primary seal has been revised upward to $98.40/meter ($30.00/foot) and the expected lifetime of the seals revised downward to 10 years

(refer to Section 2.5.3.2, Floating Roof Vessels). The cost of fitting controls has also been revised (refer to Section 2.2.4, Column Fittings, and Section 2.5.3.2, Floating Roof Vessels). These changes have been incorporated into the analysis of the fifth year economic impact of the standards. The fifth-year impact still yields a net credit.

1.2.4 Other Considerations

1.2.4.1 Irreversible and Irretrievable Commitment of Resources. The Volume I BID concluded in Chapter 7 that no long-term environmental losses would result from the regulatory alternatives. The regulatory alternatives do not preclude the development of future control options that would be beneficial to the environment. The analysis of the final standards remains unchanged in this respect.

1.2.4.2 Environmental and Energy Impacts of Delayed Standards. As discussed in Chapter 7 of the Volume I BID, the only environmental impact associated with a delay in proposing and promulgating the standards would be an increase in VOC emissions from storage tanks attributable to the construction of new tanks.

1.2.4.3 Urban and Community Impacts. There are no urban and community impacts attributable to the proposed or promulgated standards.

2. SUMMARY OF PUBLIC COMMENTS

A list of commenters, their affiliations, and the EPA docket entry number assigned to each comment are shown in Table 2-1. Twenty-four letters containing comments on the proposed standards for VOL storage vessels and the BID for the proposed standards were received. Significant comments have been organized into the following six categories:

1. Selection of Affected Facility;
2. Emission Control Technology;
3. Recordkeeping, Reporting, and Inspection Requirements;
4. Modification;
5. Cost Effectiveness; and
6. Miscellaneous.

The comments and the issues they address are discussed in the following sections of this chapter.

2.1 SELECTION OF AFFECTED FACILITY

2.1.1 Vapor Pressure and Tank Size Cutoff

Comment: Several commenters questioned the 3.5 kPa (≈0.51 psia) vapor pressure cutoff for tanks with capacities greater than 151 m^3 (≈40,000 gal). Two commenters (IV-D-18, IV-D-21) said that the proposed regulation should be consistent with the existing Subparts K and Ka and limit application of controls to vessels over 151 m^3 (≈40,000 gal) in capacity that store liquids with true vapor pressures above 10.4 kPa (≈1.5 psia). One commenter (IV-D-15) suggested that the 10.4 kPa (1.5 psia) cutoff be maintained to achieve consistency with State implementation plans (SIP's).

Response: Section 111 of the Clean Air Act requires EPA to establish standards that reflect best demonstrated technology (BDT). The EPA has identified BDT for tanks storing liquids in the vapor pressure range of

TABLE 2-1. LIST OF COMMENTERS ON PROPOSED STANDARDS OF PERFORMANCE FOR VOLATILE ORGANIC LIQUID STORAGE VESSELS

Docket item No.[a]	Commenter/affiliation
IV-D-1	Mr. Richard E. Grusnick Air Division Alabama Department of Environmental Management 1751 Federal Drive Montgomery, Ala. 36109
IV-D-2	Mr. D. E. Park Director, Corporate Environmental Affairs Ethyl Corporation P.O. Box 341 Baton Rouge, La. 70821
IV-D-3	Mr. Bruce Blanchard Director, Environmental Project Review U.S. Department of the Interior Office of the Secretary Washington, D.C. 20240
IV-D-4	Mr. Fin Johnson North Carolina Department of Natural Resources and Community Development P.O. Box 27687 Raleigh, N.C. 27611
IV-D-5	Mr. Robert F. Brothers Director, Regulatory Affairs Eastman Kodak Company 343 State Street Rochester, N.Y. 14650
IV-D-6	Mr. Peter W. McCallum Senior Corporate Environmental Scientist The Standard Oil Company (Ohio) Midland Building Cleveland, Ohio 44115
IV-D-7	Mr. J. K. Walters Director, Measurement Coordination American Petroleum Institute 1220 L Street, N.W. Washington, D.C. 20005

(continued)

TABLE 2-1. (continued)

Docket item No.[a]	Commenter/affiliation
IV-D-8	Mr. W. T. Danker Manager, Environmental Programs Environment, Safety, Fire and Health Chevron U.S.A. Inc. P.O. Box 7643 San Francisco, Calif. 94120
IV-D-9	Mr. A. H. Nickolaus Chairman, CTG Subcommittee Air Conservation Committee Texas Chemical Council 1000 Brazos, Suite 200 Austin, Tex. 78701
IV-D-10	Mr. M. E. Miller, Jr. Manager, Environmental Engineering Unit R. J. Reynolds Tobacco Company Winston-Salem, N.C. 27102
IV-D-11	Mr. John J. Moon Manager, Environment and Consumer Protection Phillips Petroleum Company Bartlesville, Okla. 74004
IV-D-12	Dr. Geraldine V. Cox Vice President Technical Director Chemical Manufacturers Association 2501 M Street, N.W. Washington, D.C. 20037
IV-D-13	Mr. Ronald F. Black Environmental Specialist Rohm and Haas Company Engineering Division P.O. Box 584 Bristol, Pa. 19007
IV-D-14	Mr. Lawrence B. Gotlieb Assistant General Counsel Distilled Spirits Council of the United States, Inc. 1250 Eye Street, N.W., Suite 900 Washington, D.C. 20005

(continued)

TABLE 2-1. (continued)

Docket item No.[a]	Commenter/affiliation
IV-D-15	Mr. Tom E. Lingafeller Manager, Environmental Regulatory Activities for Air Dow Chemical U.S.A. 2030 Willard H. Dow Center Midland, Mich. 48640
IV-D-16	Mr. Phillip L. Youngblood Director, Air Programs Conoco Inc. Suite 2136 P.O. Box 2197 Houston, Tex. 77252
IV-D-17	Mr. Walter Roy Quanstrom General Manager Environmental Affairs and Safety Department Standard Oil Company (Indiana) 200 East Randolf Drive Chicago, Ill. 60601
IV-D-18	Mr. John Prokop President and General Counsel Independent Liquid Terminals Association 1133 15th Street, N.W. Suite 204 Washington, D.C. 20005
IV-D-19	Mr. Kirk F. Sniff Manager, Environmental Section Legal Department The Southland Corp. P.O. Box 719 Dallas, Tex. 75221
IV-D-20	Mr. Joseph J. Zlogar Environmental Engineer Northern Petrochemical Company P.O. Box 459 Morris, Ill. 60450

(continued)

TABLE 2-1. (continued)

Docket item No.[a]	Commenter/affiliation
IV-D-21	Mr. L. G. Lund Manager of Regulatory Affairs Health, Environment and Safety Himont U.S.A., Inc. P.O. Box 1687 Lake Charles, La. 70602
IV-D-22	Mr. L. K. Arehart Supervisor, Regulatory Analysis Health and Environmental Affairs Department Diamond Shamrock Corp. 717 North Harwood Street Dallas, Tex. 75201
IV-D-23	Mr. Alan T. Roy Allied Corp. Fibers Division Margaret and Bermuda Streets Philadelphia, Pa. 19137
IV-D-39	Mr. Walter G. Wright, Jr. Assistant Counsel Petroleum Marketers Association of America 1120 Vermont Avenue, N.W. Suite 1130 Washington, D.C. 20005

[a]The docket No. for this project is A-80-51. Dockets are on file at EPA Headquarters in Washington, D.C. and at the Office of Air Quality Planning and Standards in Durham, N.C.

5.2 to 10.4 kPa (0.75 to 1.5 psia) and is, therefore, promulgating standards reflecting BDT. (Refer to the next response for an explanation of changes made to the vapor pressure cutoff.) Consistency with some SIP's or with the existing standards (Subparts K and Ka) is not germane.

Comment: Two commenters (IV-D-15, IV-D-18) stated that no data are presented that show a significant reduction in emissions from vessels storing liquids between 3.5 and 10.4 kPa (0.51 and 1.5 psia). One commenter (IV-D-15) said that no evidence is presented showing that emissions from these vessels contribute to ozone formation. Another commenter (IV-D-21) maintained that control of vessels storing liquids having vapor pressures between 3.5 and 10.4 kPa (0.51 and 1.5 psia) would not contribute greatly to the reduction in emissions, and these vessels are less cost effective to control than vessels storing liquids with vapor pressures above 10.4 kPa. One commenter (IV-D-18) said that the emission reduction attributed to vessels of this size class is overstated at "for-hire" terminals because of the low turnover rate (approximately five per year) on these vessels. He suggested that the number of turnovers be added as a cutoff criterion. This commenter also suggested that floating roof vessels average at least 10 annual turnovers and fixed roof vessels average at least 50 annual turnovers before becoming subject to the control requirement.

Response: These comments address three issues related to the selection of affected facilities: (1) the cost effectiveness of controlling emissions from vessels storing VOL's with vapor pressures between 3.5 and 10.4 kPa (0.51 and 1.5 psia), (2) the use of annual turnovers as an exemption or cutoff criterion; and (3) the contribution of the standards at the proposed level to emission reduction.

The Agency reevaluated the cost effectiveness of controlling emissions from vessels storing VOL's in this vapor pressure range. The Agency recognizes that there will be variations in cost-effectiveness values within a class. In particular, certain subclasses of vessels (for example, vessels storing low vapor pressure liquids) may have unreasonable cost-effectiveness values, particularly when combined with other storage parameters such as low annual turnovers. Therefore, the Agency has limited the scope of the standards to preclude some of those vessels

storing low vapor pressure chemicals, which may have unreasonable cost-effectiveness values. This has been done by changing the vapor pressure cutoff from 3.5 to 5.2 KPa (0.51 to 0.75 psia). While the exact number of vessels excluded by the revision of the vapor pressure cutoff is not known, the change in emission reduction is small.

It should be noted that cost effectiveness is not a measure of the economic impact of the standards on individual owners. Rather, it is a measure of the overall cost efficiency for various classes of sources subject to the standard. Because it is practical to do so without affecting the objectivity and enforceability of the standards, the Agency has limited the scope of the standards to preclude some of the vessels that have unreasonable cost-effectiveness values. Nevertheless, variation in cost-effectiveness values among individual facilities does remain; however, this is expected and is not unreasonable.

Furthermore, these cost-effectiveness estimates do not reflect the indirect environmental benefits of these standards. Emissions from storage of some potentially toxic chemicals will be controlled under these standards. It was not possible to quantify these benefits in this case; nonetheless, the existence of these benefits, in light of the difficulty of making additional distinctions among classes of tanks, was a factor in the Agency's determination that the cost effectiveness of the standards is reasonable.

The Agency also considered an exemption based on turnovers. The Agency evaluated the cost effectiveness of BDT controls for a typical chemical industry tank (a volume of 606 m^3 [160,000 gal], diameter and height of 9.2 m [30 ft]). Tanks of this volume associated with the chemical industry typically turn over 60 times per year. However, in this case, the analysis was conducted assuming 10 turnovers per year to evaluate the cost effectiveness of controls at a low turnover rate. A molecular weight of 80, a vapor pressure of 6.9 kPa (1.0 psia), and a product value of $360/Mg were also assumed. The cost effectiveness of BDT is about $1,140/Mg for this case.[1]

The commenter (IV-D-18) correctly noted that the Agency's analysis of tanks in this size range was based on a turnover rate of 50. Because the number of turnovers does play a role in the cost effectiveness of BDT

controls for fixed roof tanks, the Agency examined the impact of low turnover rates on the cost effectiveness of BDT controls in this vapor pressure range (3.5 to 10.4 kPa [0.51 to 1.5 psia]). As the number of turnovers decreases, fixed roof tank emissions will decrease, the emission reduction obtained by BDT will decrease, and, therefore, BDT will become less cost effective.

The average volume of a tank at a "for-hire" terminal is about 3,300 m^3 (871,000 gal). The analysis assumed a diameter of about 18.4 m (60 ft), a height of about 12.2 m (40 ft), a mid-range vapor pressure (6.9 kPa or 1.0 psia), a molecular weight of 80, and a product value of $360/Mg. Built as a fixed roof tank, this vessel would emit 7.2 and 5.3 Mg/yr (7.9 and 5.8 tons/yr) at 5 and 2.5 turnovers per year, respectively. The emission reductions obtained by constructing a BDT internal floating roof tank in place of a fixed roof tank are about 6.7 and 4.8 Mg/yr (7.4 and 5.3 tons/yr) at 5 and 2.5 turnovers, respectively; and the associated cost-effectiveness values are $520/Mg and $870/Mg at 5 and 2.5 turnovers, respectively.[1]

An exemption based on annual turnovers is not possible without affecting the objectivity and enforceability of the standards. The number of turnovers that any vessel storing VOL's undergoes is not constant from year to year and cannot be predicted with certainty at the time a vessel is built or reconstructed. Thus, standards designed to exempt individual vessels that may have low turnover rates would be impractical both from an enforcement perspective and from the owner's perspective.

The Agency has concluded that, even in cases of low turnover rates, the control of vessels storing liquids with vapor pressure between 5.2 and 10.4 kPa (0.75 and 1.5 psia) is reasonable. As discussed above, a cutoff based on turnovers is not practical even for those instances where cost-effectiveness values are high. Therefore, because the overall cost of the standards produces a net credit and because an exemption for the subclass of low-turnover vessels is not practical, no changes based on turnovers have been made to the proposed cutoffs in these final standards. However, the final standards will reflect the change in vapor pressure cutoff.

The emission reduction achieved between 3.5 and 10.4 kPa (0.75 and 1.5 psia) cannot be quantified. However, the cost effectiveness of

typical tanks in this vapor pressure range is reasonable. Also, the overall emission reduction of the standards is 31,000 Mg (34,000 tons) and results in a net annual credit. Therefore, this cutoff is reasonable.

Comment: One commenter (IV-D-12) requested that EPA reevaluate the inclusion of small-volume (75- to 151-m^3 [20,000- to 40,000-gal]) vessels by using a range of annual turnovers. According to the commenter, low turnover rates (less than 10 per year) for these vessels are not cost effective. Another commenter (IV-D-18) said that the turnover rate for 75- to 151-m^3 (20,000- to 40,000-gal) vessels in the for-hire terminal industry is as low as 2.5 to 4 times per year. This commenter said that EPA's selection of higher turnover rates results in overstated emission reduction and understated cost-effectiveness values. A third commenter (IV-D-9) requested that justification and data be given to support EPA's selection of the turnover rate (50 per year) used in determining size cutoffs.

Response: Data on turnovers are not available for tanks at terminals (5.9 percent of the tank population) or petroleum refineries (approximately 56 percent of the tank population). These data are available for chemical industry tanks (38 percent of the tank population) in the 75- to 151-m^3 (20,000- to 40,000-gal) size range. For example, a 75-m^3 (20,000-gal) tank in the chemical industry averages 260 turnovers per year. Assuming as a worst case that the remaining 62 percent of the tanks only have four turnovers per year, the average number of turnovers for a 75-m^3 (20,000-gal) tank would be about 100. Therefore, 50 turnovers per year is a conservative analytical basis for determining the cutoff.

While data on turnovers are not available for tanks located at terminals, the Agency was able to examine the possibility of significant numbers of small volume, low turnover vessels being located at terminals. While some petroleum products such as gasoline meet the small volume vapor pressure cutoff (27.6 kPa [4 psia]), these products are typically stored in much larger tanks. According to an organic chemical manufacturing data base, only 0.3 percent of the total storage volume of organic chemicals is shipped and available, thereby, for storage at for-hire terminals. Of this, less than 13 percent of the volume shipped consists of liquids in the higher vapor pressure range (27.6 to 76.6 kPa

[4 to 11.1 psia]) that would be affected under the standards in the 75- to 151-m^3 (20,000- to 40,000-gal) size range.[2] Therefore, the Agency considers it unlikely that a significant number of storage vessels at terminals in this size range would be affected by the standards. Despite this, the Agency examined the cost effectiveness of BDT controls in a 113-m^3 (30,000-gallon) tank for four specific liquids stored at terminals and at two turnover rates (5 and 10 per year). Typical vessels located at terminals turn over five times per year according to one industry source. The results of these analyses are presented in Table 2-2.[1] The cost effectiveness at five turnovers annually ranged from $920/Mg to $2,570/Mg and averaged $1,500/Mg. The cost effectiveness at 10 turnovers annually ranged from a savings of $160/Mg to a cost of $890/Mg and averaged $310/Mg. While BDT for these low turnover vessels results in higher cost-effectiveness values than those for vessels with higher turnovers, these costs are reasonable considering the difficulty of discriminating between tanks with different turnover rates. As noted previously, larger vessels, which are more common in the for-hire terminal industry, are even more cost effective to control.

The actual cost effectiveness of BDT controls is dependent upon tank-specific parameters (diameter, height, and volume) and product-specific parameters (vapor pressure, molecular weight, and chemical formulation) that cannot be predicted and may be higher or lower than those presented in Table 2-2. Because of these variable parameters, an objective exemption that would exempt only those vessels that always have low turnovers would be complex and impractical. Therefore, because the average cost effectiveness is reasonable even at lower turnovers, no changes in the volume cutoffs have been made in the final rule.

Comment: One commenter (IV-D-12) suggested that a range of diurnal temperatures and product molecular weights be used in determining the cutoff for vessels less than 151 m^3 (40,000 gal) in capacity. Commenters (IV-D-9, IV-D-12) said that the choice of an 11.1°C (20°F) diurnal temperature change does not represent the norm and advised that an 8.3°C (15°F) change would be more realistic. Two commenters (IV-D-12, IV-D-18) noted that the use of a single molecular weight results in overly-generalized analysis.

TABLE 2-2. COST EFFECTIVENESS OF BDT CONTROLS FOR A 113-m^3 TANK[1]
(Fourth-quarter 1984 dollars)

Compound	Cost effectiveness at 5 turnovers/yr, $/Mg	Cost effectiveness at 10 turnovers/yr, $/Mg
n-Pentane	1,600	460
Cyclopentane	2,570	890
Isoprene	1,350	300
Ethyl Ether	920	(160)
Average	1,500	310

Response: Storage facilities located in coastal areas generally experience lower average diurnal temperature changes than vessels located further inland. However, an 11.1°C (20°F) change represents the national norm. The average diurnal temperature change for the States of California, Texas, Louisiana, and New Jersey was calculated to be 10.3°C (18.5°F), which indicates that even in coastal States with a high proportion of the nationwide storage population, the average diurnal temperature change is greater than that suggested by the commenters.[3]

The cost effectiveness of a 75-m^3 (20,000-gal) tank storing a typical VOL was examined for sensitivity to use of a 8.3°C (15°F) diurnal temperature change. The selection of this diurnal temperature change value affects the magnitude of breathing losses on the order of 13 percent. Breathing losses are typically small (approximately 10 percent in this case), and the impact of changing the temperature factor on the cost effectiveness of control is small. The cost effectiveness of storing a typical VOL was $311/Mg when an 11.1°C diurnal temperature change was assumed, and was $325/Mg when an 8.3°C temperature change was assumed.[3] Because emission rates are not affected to an excessive extent by differing diurnal temperature changes and considering the impracticability of basing a national standard on differing local temperature conditions, no change has been made in the final standards.

The Agency has adequately considered a range of molecular weights in developing the standards. The responses to other comments on the proposed standards utilize analyses based on a variety of product molecular weights. The average cost effectiveness of controls is reasonable under a wide range of storage situations, including varying molecular weights and product prices.

Comment: Three commenters (IV-D-7, IV-D-8, IV-D-12) noted that the American Petroleum Institute (API) is revising Bulletin No. 2518 that provides the basis for estimates of evaporation loss from fixed roof tanks. Two commenters (IV-D-7, IV-D-8) also noted that API is conducting a test program to evaluate evaporation loss from fittings in external floating roof tanks. According to one commenter (IV-D-7), the new estimates of emissions from fixed roof vessels could alter the baseline emission level. The other commenter (IV-D-12) noted that the new fixed

roof emission estimates will include the effects of losses from tanks with pressure vacuum vents. Because the existing estimates do not include this variable, the commenter recommended that EPA delay making a determination on small size cutoffs until the revised estimates are available. Another commenter (IV-D-8) requested that EPA await the results of both emission estimate revisions before finalizing the proposed standards because of possible changes in the baseline emission level.

Response: The Agency considered the benefits of delaying promulgation of the proposed standards until the results from the API test program are available. A delay would allow the development of external floating roof fitting loss equations, which would quantify more precisely the emission reduction achievable with the use of BDT. However, if it is assumed that the emission reduction achieved by controlling emissions from external floating roof fittings would be comparable to the reduction achieved with internal floating roof fittings, this reduction would be very small in comparison to the overall emission reduction achieved by the standard. Therefore, the benefits of proceeding with final standards for external floating roof tanks outweigh the benefits of delaying the standards.

The fixed roof test program has the potential to modify the breathing loss equations and to quantify the emission reduction obtained by using vents. However, breathing losses are generally small (approximately 15 percent in the typical storage vessel that is 606 m^3 [160,000 gal]), and a reduction in breathing losses would not make a significant difference in the cost effectiveness of internal floating roofs as a control device.

The Agency also considered the fact that research test programs of this nature have uncertain completion dates and that there is no guarantee that the program will be completed in a timely manner. A proposal without subsequent, timely promulgation leaves the industry in an uncertain position with respect to how affected facilities should achieve compliance. The uncertainty also has a negative impact with respect to State air programs and the issuance of permits.

Therefore, for the reasons noted above, the Agency has determined that there are no benefits to be obtained from delaying the standards and

has decided to proceed. It should be noted, however, that data from a completed test program will be incorporated into the next review of these standards and into the next revision of the EPA Publication AP-42.

2.1.2 Vapor Pressure Determination

Comment: Two commenters (IV-D-5, IV-D-9) suggested that EPA use the annual average temperature instead of the maximum monthly average temperature to determine maximum true vapor pressure. The commenters said that this would be consistent with EPA's procedure for analyzing emissions and cost effectiveness. A third commenter (IV-D-18) requested clarification regarding which temperature should be used. The commenter also questioned the fairness of requiring controls on vessels containing liquids that may exceed the vapor pressure threshold only one day per year or less.

Response: The EPA agrees that affected liquids may have vapor pressures that are below the cutoffs for much of the year but also notes that nonaffected liquids may have true vapor pressures above the cutoffs for portions of the year such as daylight hours during summer months. In developing the applicability provision, EPA realized that basing applicability on maximum instantaneous vapor pressure would result in the broadest applicability and, therefore, the largest emission reduction. This approach could cause planning problems for the industry because owners and operators might not be able to adequately predict which vessels would be affected. Because industry may not be able to account for particularly hot days adequately, the instantaneous vapor pressure was rejected as the basis of applicability.

The next applicability format examined was an annual average vapor pressure. This format has the advantage that it is in line with the emission calculation methodologies used in the BID. However, vapor pressures of VOL's are higher in the warmer, summer months, when ambient ozone levels are highest. If applicability were based on the annual average vapor pressure, vessels would not come under the standards even though they were storing liquids with true vapor pressures greater than 5.2 kPa (0.75 psia). These vessels would then emit significant quantities of VOC's during the summer when ambient ozone levels are highest. Therefore, EPA decided to examine a shorter time frame that would broaden the applicability of the standards, particularly during the summer.

An applicability based on maximum monthly average vapor pressure was selected because this would have a broader applicability than annual averages without the planning problems associated with an applicability based on instantaneous vapor pressure and would base applicability on the contribution to VOC emissions when ozone levels are highest. The unit time basis of vapor pressure determination in the promulgated standards remains unchanged from that in the proposed standards.

2.1.3 Special Exemptions

2.1.3.1 Horizontal and Underground Vessels. The fact that horizontal and underground storage vessels were not specifically excluded from the proposed standards prompted several comments.

Comment: Three commenters (IV-D-1, IV-D-16, IV-D-39) requested that underground storage vessels at gasoline service stations be exempted from the rulemaking. One commenter (IV-D-1) stated that it would be an unnecessary recordkeeping burden for both the operators of smaller affected vessels not subject to the control requirements and the regulatory agencies that would have to keep the records. Two commenters (IV-D-1, IV-D-16) stated their belief that it was not EPA's intent to include underground storage vessels at gasoline service stations as affected facilities.

Response: Commenters are correct in their assertion that EPA did not intend to affect vessels at gasoline service stations with these standards. Consequently, no evaluation of the possible economic impact of these standards on gasoline marketers was performed. Emissions from retail gasoline marketers are part of the gasoline marketing source category (Petroleum Transportation and Marketing, 40 CFR § 60.16, Category No. 23), as well as part of the VOL storage category. The decision as to whether to regulate emissions from these vessels is being made in a regulatory decision package for that category. The Agency has decided to specifically exempt storage vessels at gasoline service stations from the final standards.

Comment: Commenters (IV-D-7, IV-D-16, IV-D-39) suggested that underground storage vessels be excluded when the volume of liquid added to and taken from the tank in a year does not exceed twice the volume of the vessel. A provision of this nature is included in Subparts K and Ka, and the commenters requested that it also be included in Subpart Kb.

Response: It is impracticable to control emissions from underground tanks with internal floating roofs. Emissions from these tanks can be controlled with vapor recovery or disposal systems designed and operated in compliance with these standards. While the cost effectiveness of vapor recovery or disposal systems in these isolated instances may be high, cost effectiveness is not a measure of economic impact. Rather, it is a measure of the cost efficiency of controlling subclasses of vessels. The overall cost of these standards is a net credit. Additionally, above-ground internal or external floating roof tanks equipped with the controls required by the standards could be constructed in lieu of underground storage vessels. Therefore, the Agency has decided not to include this exemption in the promulgated standards. It should be noted that the exemption does continue for vessels constructed after the date of proposal for Subpart K but prior to the proposal of Subpart Kb.

Comment: One commenter (IV-D-5) contended that the BID does not support the inclusion of underground storage vessels, particularly those smaller than 100 m^3 (26,000 gal) in capacity. The commenter also noted that emissions from these vessels are excessively costly to control. According to the commenter, installations storing VOL for use in manufacturing operations may need one or two horizontal, underground tanks as large as 95 m^3 (25,000 gal) to store material received from railroad tank cars that have capacities up to 75 m^3 (20,000 gal). The commenter recommended that an exemption be included in the proposed standard for underground storage vessels with capacities less than 100 m^3.

Response: Further discussions with the commenter revealed that the commenter's primary concern was that some manufacturing plants may not have adequate space to install aboveground tanks.[4] According to Factory Mutual Research, adequate spacing of tanks is necessary to reduce the possibility of the spread of fire from the tank initially involved to exposed structures or adjacent tanks. For example, a 75-m^3 (20,000-gal) tank would have to be placed at least 7.5 to 15 m (25 to 50 ft) away from buildings depending on the flammability of the liquid being stored. The minimum tank-to-tank spacing is one-half the diameter of the largest tank; 4.3 m (14 ft) in the case of adjacent 75-m^3 (20,000-gal) tanks. In contrast, underground tanks may be located as close as 1.5 m (5 ft) to building foundations and 0.6 m (2 ft) from other tanks and pipelines.[5]

Aboveground tanks are a proven and safe method of storage, and there appear to be no technical reasons why aboveground tanks could not be installed in place of underground tanks when space permits. Furthermore, it is expected that space would not be a problem at new plants because they can be designed to allow sufficient space for aboveground tanks. However, EPA cannot predict which existing facilities may have spacing problems in installing new aboveground tanks. In cases where space is a problem, the owner or operator may install underground tanks equipped with add-on controls allowed by § 60.112b(a)(3).

The cost effectiveness of controlling emissions from a 113-m^3 (30,000-gal) capacity underground tank is about $2,100/Mg.[6] This assumes the tank undergoes 10 turnovers per year, which is typical for the commenter's industry. While this is higher than the cost effectiveness of BDT control (i.e., floating roof) in comparable tanks ($310/Mg as shown in Table 2-2), the overall cost of the standards is a net credit.[1] Therefore, the final standards will not be revised to include a blanket exemption for underground storage vessels because adequate means of complying with the standards (aboveground vessels or underground vessels equipped with add-on controls) exist.

Comment: One commenter (IV-D-22) noted that horizontal tanks are used widely in the synthetic organic chemical manufacturing industry (SOCMI). The commenter said that because floating roofs cannot be used in these tanks, there is a problem in applying the proposed standards to them.

Response: The standards provide three fundamentally different methods of compliance:

1. External floating roof tanks equipped with liquid-mounted or mechanical shoe primary seals and a rim-mounted secondary seal;

2. Internal floating roof tanks equipped with liquid-mounted or mechanical shoe primary seals or vapor-mounted primary and secondary seals and gasketed fittings; or

3. A 95 percent effective vapor control system. Horizontal tanks are typically small (volumes rarely exceed 113 m^3 [30,000 gal]), and because external floating roof tanks are rarely smaller than 492 m^3 (130,000 gal), these horizontal tanks could not be constructed as new

external floating roof tanks. However, the other options allowed by the standard are suitable for vessels in the size range of horizontal tanks. In subsequent discussion, the commenter agreed that vertical tanks equipped with internal floating roofs could be used in place of horizontal tanks although in instances such as separation processes horizontal tanks were advantageous.[7]

Additional information was obtained from the State of Texas on the issue. Texas requires equipment similar to BDT (internal floating roofs) for all new storage vessels with capacities of 95 m^3 (25,000 gal) or greater storing liquids with vapor pressures of 3.5 kPa (0.51 psia) or greater and, thus, currently requires controls on vessels of concern to the commenter. Texas Air Control Board (TACB) personnel have stated that, in their permitting experience, there are very few circumstances in which the tanks must be horizontal. If a horizontal tank is used, the TACB generally requires add-on control systems (carbon adsorption or thermal oxidation).[8]

Previous studies of storage in the chemical industry indicate that add-on control systems are cost effective (less than $1,000/Mg) for tanks with volumes less than 151 m^3 (40,000 gal) storing liquids with high vapor pressures. For example, as shown in Table 2-3, the average cost effectiveness of a 95 percent efficient condenser for chloroform storage at chloroform production facilities is $630/Mg.[9] This issue was further analysed by examining the cost effectiveness of controlling a 113-m^3 (30,000-gal) horizontal tank as a function of turnover rate and filling rate. While turnover rates of 170 times per year are typical for vessels in this size range in the chemical industry, cases were analyzed assuming 5 and 10 turnovers per year. As shown in Tables 2-4 through 2-6, the average cost effectiveness ranged from $650/Mg to $1,540/Mg.[10] This range is judged to be reasonable. The standards are achievable and, in many cases, are cost effective even if atypical turnover rates are assumed and if add-on controls are adopted. Furthermore, according to an organic chemical manufacturing data base, only 0.22 percent of vessels with volumes between 75 m^3 and 151 m^3 (20,000 gal and 40,000 gal) are used to store liquids with vapor pressures between 27.6 kPa and 58.7 kPa (4 psia and 8.5 psia).[11] For vessels of all sizes, only 8 percent of fixed roof

TABLE 2-3. COST EFFECTIVENESS OF 95 PERCENT EFFICIENT CONDENSER FOR CHLOROFORM STORAGE AT CHLOROFORM PRODUCTION FACILITIES[9]
(July 1982 $/Mg)

Plant	Location	Net annualized cost, $/yr	Emission reduction, Mg/yr	Cost effectiveness, $/Mg
Diamond Shamrock	Belle, W. Va.	24,800	8.8	2,800
Dow	Freeport, Tex.	30,000	2.2	13,300
Linden	Moundsville, W. Va.	20,600	15.0	1,370
Vulcan	Wichita, Kans.	(16,000)[a]	68.6	(230)
Average				630[b]

[a] ( ) Indicates a net credit due to chloroform recovery.

[b] Average cost effectiveness = $\frac{\Sigma \text{ net annualized costs}}{\Sigma \text{ emission reduction/yr}}$

TABLE 2-4. COST EFFECTIVENESS OF A 95 PERCENT (MASS) EFFICIENT CONDENSER[a,10]

Compound	Vapor pressure at 70°F, psia	Installed capital cost, Dec. 1982 $	Total annualized cost, $/yr	Product value, $/Mg	Emission reduction, Mg/yr	Cost effectiveness, $/Mg
n-Pentane	8.433	15,800	5,100	430[b]	4.0	850
Cyclopentane	5.240	11,400	3,620	526[c]	2.3	1,050
Isoprene	9.668	17,100	5,570	530[d]	4.6	680
Ethyl Ether	8.702	15,800	5,100	970[e]	4.3	220
Average						650

[a]Basis: 30,000 gallon horizontal tank; 10 turnovers/yr; filling rate = 100 gal/min.
[b]Quoted December 21, 1984, by Ashland Chemical Company converted to December 1982 dollars.
[c]Quoted December 21, 1984, by Phillips Chemical Company converted to December 1982 dollars.
[d]Quoted December 21, 1984, by Research Triangle Institute converted to 1982 dollars.
[e]Quoted from December 17, 1984, Chemical Marketing Reporter, converted to December 1982 dollars.

TABLE 2-5. COST EFFECTIVENESS OF A 95 PERCENT (MASS) EFFICIENT CONDENSER[a,18]

Compound	Vapor pressure at 70°F, psia	Installed capital cost, Dec. 1982 $	Total annualized cost, $/yr	Product value, $/Mg	Emission reduction, Mg/yr	Cost effectiveness, $/Mg
n-Pentane	8.433	15,800	5,100	430[b]	3.2	1,160
Cyclopentane	5.240	11,400	3,620	526[c]	1.7	1,600
Isoprene	9.668	17,100	5,570	530[d]	3.6	1,020
Ethyl Ether	8.702	15,800	5,100	970[e]	3.4	530
Average						1,000

[a]Basis: 30,000 gallon horizontal tank; 5 turnovers/yr; filling rate = 100 gal/min.
[b]Quoted December 21, 1984, by Ashland Chemical Company converted to December 1982 dollars.
[c]Quoted December 21, 1984, by Phillips Chemical Company converted to December 1982 dollars.
[d]Quoted December 21, 1984, by Research Triangle Institute converted to December 1982 dollars.
[e]From December 17, 1984, Chemical Marketing Reporter, converted to December 1982 dollars.

TABLE 2-6. COST EFFECTIVENESS OF A 95 PERCENT (MASS) EFFICIENT CONDENSER[a,18]

Compound	Vapor pressure at 70°F, psia	Installed capital cost, Dec. 1982 $	Total annualized cost, $/yr	Product value, $/Mg	Emission reduction, Mg/yr	Cost effectiveness, $/Mg
n-Pentane	8.433	25,700	8,600	430[b]	4.0	1,720
Cyclopentane	5.240	19,100	6,280	526[c]	2.3	2,200
Isoprene	9.668	28,100	9,470	530[d]	4.6	1,530
Ethyl Ether	8.702	25,700	8,600	970[e]	4.3	1,030
Average						1,540

[a]Basis: 30,000 gallon horizontal tank; 10 turnovers/yr; filling rate = 200 gal/min.
[b]Quoted December 21, 1984, by Ashland Chemical Company converted to December 1982 dollars.
[c]Quoted December 21, 1984, by Phillips Chemical Company converted to December 1982 dollars.
[d]Quoted December 21, 1984, by Research Triangle Institute converted to December 1982 dollars.
[e]From December 17, 1984, Chemical Marketing Reporter, converted to December 1982 dollars.

storage capacity in the industry is dedicated to storage of liquids with vapor pressures between 20.7 kPa and 103.4 kPa (3 psia and 15 psia).[2] Based on this information, it is reasonable to assume that only a very small proportion of potential new sources of fixed roof tanks would be affected by the standards. Therefore, no exemption for horizontal vessels has been incorporated into the final rule.

2.1.3.2 Facilities Producing Beverage Alcohol.

Comment: One commenter (IV-D-14) requested that EPA grant an exemption from the proposed standards for vessels used to store non-industrial, distilled beverage alcohol. The commenter requested the exemption for the following reasons: (1) producers of distilled spirits are insignificant sources of VOC emissions, (2) the suggested control technology would either be extremely damaging to the product as a food item or would be proscribed by existing Federal regulations, and (3) thecosts and other problems that would result from implementation of the proposed standards would violate Executive Order 12291.

Response: The Agency concurs with the commenter that the proposed control technologies required by these standards could contaminate beverage alcohol, resulting in a product with little or no market value. Also, because beverage alcohol was exempted from the priority list as part of the SOCMI source category (44 FR 49222) and because it is not a petroleum liquid, storage vessels containing beverage alcohol are exempt from the final standards. However, any storage vessels that are used to store nonbeverage, fermented products are subject to the standards if they are found to be affected facilities.

2.1.3.3 Vessels Located on the Outer Continental Shelf (OCS).

Comment: One commenter (IV-D-3) noted that the U.S. Department of the Interior, not EPA, is authorized to regulate air emissions from oil and gas operations on the OCS. It was recommended that VOL and petroleum liquid storage vessels located on the OCS be exempted as affected facilities for this reason.

Response: Under the Outer Continental Shelf Lands Act (OCSLA), the Secretary of Interior is authorized to issue air emission regulations for activities located on the OCS. However, the Agency does not construe this authority as exclusive jurisdiction. Under the authority of the Clean Air

Act, the Agency is required to control air emissions from new, modified, or reconstructed sources, including sources on the OCS (see Sections 4(a)(1) and 21(d) of OCSLA, 42 U.S.C. 1333(a)(1), 1347(d)). Because of this authority, the Agency has decided not to exempt specifically vessels located on the OCS from the final standards.

In any event, the final standards do exempt vessels that store liquids prior to custody transfer as defined in § 60.111b, unless the vessels have a design capacity greater than 1,589.7 m^3 (420,000 gal). A study of offshore oil and gas production facilities indicated that if a platform has storage vessels, those vessels store liquids that have not undergone custody transfer. Therefore, the Agency believes OCS vessels are exempt from the standards via the custody transfer provision.

2.1.3.4 "Slop Oil," Wastewater, and Waxy, Heavy Crude Oil Storage Vessels.

Comment: One commenter (IV-D-6) requested an exemption to the recordkeeping requirements for tanks used to store a mixture of different products ("slop oil"). The commenter said that the constantly changing nature of the products and the associated vapor pressure in these vessels would necessitate physical testing to determine vapor pressure as required in the proposed standards. According to the commenter, these vessels represent a small portion of the vessels at any one facility, and little benefit, if any, would be gained by including them in the vapor pressure recordkeeping requirements.

Response: The purpose of the vapor pressure determination is to distinguish among the three possible classes of VOL's that are of concern:

1. Those liquids with vapor pressures greater than or equal to a control cutoff (27.6 kPa [4 psia] for vessels with capacities of 75 m^3 [20,000 gal] or greater and 5.2 kPa [0.75 psia] for vessels with capacities of 151 m^3 [40,000 gal] or greater);

2. Those liquids that are exempt from all vapor pressure recordkeeping provisions of the standards (less than 15 kPa [2.2 psia] for vessels with capacities between 75 and 151 m^3 [20,000 and 40,000 gal] and less than 3.5 kPa [0.51 psia] for vessels with capacities of 151 m^3 [40,000 gal] or greater); and

3. Those liquids for which monitoring, but not emission control, is required (between 15 and 27.6 kPa [2.2 and 4 psia] for vessels with capacities ranging from 75 to 151 m^3 [20,000 to 40,000 gal] and between 3.5 to 5.2 kPa [0.51 to 0.75 psia] for vessels with capacities of 151 m^3 [40,000 gal] or greater).

For most chemical and petroleum products, the class to which a given liquid belongs will be obvious. For instance, the vapor pressure of No. 2 fuel oil will not exceed 5.2 kPa [0.75 psia], and, therefore, vessels storing this liquid would be exempt from all except the monitoring provisions of the standards.

Waste tanks with constantly changing mixtures pose a different issue. While a range of possible vapor pressures will be known, constant minor fluctuations in composition will prevent the determination of the actual vapor pressure without extensive (perhaps daily) testing. However, these fluctuations generally are not so large that, under normal operating conditions, large daily changes in vapor pressure would be expected. Extensive testing of these liquids would be unduly burdensome to industry without providing a corresponding benefit. Therefore, EPA sought an alternative that would preserve the intent of the requirement without being unreasonably burdensome.

Prior to construction of the vessel, the range of likely liquid compositions will be known, as will the maximum monthly average storage temperature. Given these, it is possible to estimate the vapor pressure of the mixture by Raoult's law:

$$P_t = \Sigma\ P_n X_n$$

where P_t=the total vapor pressure

P_n=the vapor pressure component

X_n=the mole fraction of a component

As with all other liquids, if the anticipated liquid composition with the highest vapor pressure is below the monitoring cutoffs, the vessel would be exempt from the standards, and no additional monitoring is needed.

For these types of liquids, the provisions for monitoring have been changed from those proposed. If the anticipated liquid composition is

above the cutoff for monitoring but below the cutoff for controls, the standards require a physical test of the vapor pressure initially and at least once every 6 months thereafter. This testing is not costly (less than $100) and would serve the intent of the proposed standards without being burdensome.[12] Records of the results will be kept, but reports will be required only in the event the vapor pressure of the stored liquid exceeds the threshold for controls.

Comment: One commenter (IV-D-16) requested that wastewater holding vessels be exempted as affected facilities. The commenter noted that use of holding vessels to retain wastewater after the organic liquids have been removed in an oil-water separator is common practice in the petroleum industry. According to the commenter, these holding vessels contain liquids with low vapor pressures such that operational monitoring and emission controls are inappropriate.

Response: The commenter has raised two issues. The first is the control of wastewater tanks. The volume and vapor pressure cutoffs have been selected so that controls are cost effective, and the control of vessels and stored liquids meeting these criteria is reasonable regardless of liquid type. Therefore, no exemption for wastewater tanks has been adopted.

The second issue is the vapor pressure monitoring requirements for these tanks. The previous comment and response deal with revised requirements for waste tanks. These revised requirements are also reasonable for wastewater tanks and would reduce the recordkeeping burden for these tanks. Therefore, the revised monitoring requirements will apply to all waste tanks, including wastewater tanks.

Comment: One commenter (IV-D-7) requested that vessels storing waxy, heavy crude oils be exempt from secondary seal requirements. According to the commenter, secondary seals are inappropriate for use with waxy, heavy crude oils due to potential operational and safety concerns.

Response: Tank vendors were contacted for further information on this issue.[13] The Agency has determined that the storage of heavy, waxy crudes is a significant problem for EFR's equipped with secondary seals. The main problem is that solid wax adheres to the shell as the deck is lowered. The wax melts as the shell wall heats during the day and runs

down the wall, over the secondary seal, and onto the deck. The wax is flammable and presents a fire hazard, plugs drains, and fouls fire protection equipment. It can also adhere the secondary seal to the shell, thereby causing damage to the seal when the deck position changes. The relatively stiff secondary seal can also scrape solid wax off the shell and throw it onto the deck as the deck is raised. As the wax melts, it can cause the problems mentioned above.

However, IFR's can be used to store heavy, waxy crudes. According to one vendor, IFR seals are softer and do not scrape wax off the shell. In addition, IFR's may be equipped with roof-mounted fire protection systems that will not be fouled by wax on the deck. Another vendor said that heavy, waxy crudes are commonly stored in internal floating roof vessels equipped with steam coils and an insulation jacket. This system keeps the wax in solution and eliminates the problem of wax buildup on the tank wall or seal system. Because these standards are achievable for heavy, waxy crudes by using IFR's, the Agency has determined that no exemption for these liquids will be included in the standards.

2.1.3.5 Negligibly Photochemically Reactive Liquids.

Comment: Two commenters (IV-D-13, IV-D-15) requested that negligibly photochemically reactive liquids such as 1,1,1-trichloroethane and methylene chloride be exempted from the proposed standards. One commenter (IV-D-18) requested that these chemicals be listed as negligibly photochemically reactive. One commenter (IV-D-15) claimed that previous VOC standards have exempted these liquids. Another commenter (IV-D-23) recommended that proposed standards list all VOC compounds to be included and exempt VOC's that are negligibly photochemically reactive. The commenter said that the inclusion of negligibly photochemically reactive liquids could increase the control costs. One commenter (IV-D-3) suggested that a listing of those compounds that are defined as VOC's be referenced in the text.

Response: Previously, the EPA has determined that the following 11 compounds are negligibly photochemically reactive:

1. Methane;
2. Ethane;
3. Methylene chloride (dichloromethane);

4. Methyl chloroform (1,1,1-trichloroethane);
5. Trichlorofluoromethane;
6. Dichlorodifluoromethane;
7. Chlorodifluoromethane;
8. Trifluoromethane;
9. Trichlorotrifluoroethane;
10. Dichlorotetrafluoroethane; and
11. Chloropentafluoroethane.

Because these compounds do not significantly contribute to the formation of ozone, the Agency agrees that the control of vessels storing these compounds would not reduce ambient ozone levels and has, therefore, exempted vessels that store only these compounds from the final rule. Because this list of compounds will change from time to time as research continues, no list of exempt compounds is included in the final rule. Rather, the approach that has been taken is to exempt each compound that has previously been declared negligibly photochemically reactive in previous Federal Register notices.

Regarding the request that a list of VOL's and/or VOC's be provided as part of the final standard, it should be noted that, in essence, the commenters are requesting that a list of all organic compounds except those determined to be negligibly photchemically reactive be provided as part of the final standards. The Agency sees no reason to add such a list to the final standards and feels that the provisions determining applicability of the NSPS are adequate without it. Therefore, no such list has been incorporated into the final rule.

2.1.3.6 Production and Process Vessels.

Comment: One commenter (IV-D-23) requested that production and process vessels having an intermediate function, not raw material or product storage, be exempted from the proposed standards. The commenter said that estimates of working losses for these vessels were incorrectly based on "total throughput." The commenter said that "net throughput" is a more realistic measure of turnovers. The commenter stated that the control technology may not be cost effective for production and process vessels. The commenter recommended that EPA reevaluate the standards using net throughput.

Response: The EPA agrees that total throughput (tank volume divided into annual liquid throughput) may not accurately reflect the actual change in liquid level (net throughput), which is an underlying mechanism of working losses. The commenter provides an example of a 75-m^3 (20,000-gal) tank that would undergo 689 turnovers per year as measured by total throughput but only 87 turnovers per year as measured by net throughput.

A representative of the Texas Chemical Council contended that turnovers based on total annual throughput overestimate turnovers based on net annual throughput by 75 to 80 percent. However, in this instance, even turnovers based on net annual throughput would range from 55 to 100 per year for tanks in the size range covered by the standards.[14] Controls on these vessels would be cost effective at these turnover rates. Further discussions with the commenter (IV-D-23) revealed that only 14 percent of the process tanks in use at the commenter's plant would come under the size and vapor pressure cutoffs of the standards if they were new sources.[15] Therefore, the Agency has determined that constant level tanks do not typically exhibit low turnover rates nor do they comprise a significant portion of tanks at chemical plants.

In further evaluating this issue, the EPA examined the cost effectiveness of controlling the sample tank cited by the commenter. Because the commenter did not fully specify the necessary tank parameters, the emission reduction obtained by BDT controls was evaluated for working losses, based on net throughput, and was assumed to be 90 percent. To be conservative, a welded steel deck with Teflon®, liquid-mounted, primary seals was costed as the control technology. Tank diameter was assumed to be 4.5 m^3 (15 ft), and product value was assumed to be $360/Mg. The calculated cost effectiveness for controlling this tank is about $910/Mg. In the case cited by the commenter, the cost effectiveness of controls is still reasonable even when calculated for actual turnovers based on net throughput.[1]

In previous studies by the EPA, model plants were developed for storage associated with selected chemical process. Some of these models include "constant level" tanks (tanks with high total throughputs but low net throughputs). These tanks were evaluated for control, and the results are presented in Table 2-7.[16,17] The average cost effectiveness was found

TABLE 2-7. COST EFFECTIVENESS OF BDT FOR CONSTANT LEVEL TANKS[16,17]

Product	Tank volume, m^3	Vapor pressure, kPa	Turn-overs	Emission reduction, Mg/yr	Product value, $/Mg[a]	Cost effec-tiveness, $/Mg
Acetone	378.5	28.84 @ 26.7°C	6	2.206	507	549[b]
Acrylonitrile	2,500	16.41 @ 27°C	6	8.282	1,003	(387)[b]
Benzene	230	7.702 @ 20°C	6	0.3044	364	3,781[b]
Crude product 1[d]	757	5.377 @ 16°C	6	19.177	400	(36)[b]
Cumene	3,785	6.275 @ 71.1°C	6	11.86	507	18[b]
Cyclohexane	213	70.67 @ 68°C	6	6.846	441	41[b]
1,2-dichloroethane	1,140	11.36 @ 27°C	6	5.252	375	1,145[c]
1,2-dichloroethane	3,800	11.36 @ 27°C	12	27.69	375	140[c]
Ethanol	4,396	5.978 @ 20.3°C	6.08	5.051	603	723[b]
Methanol	1,890	16.92 @ 27°C	6	3.911	180	959[b]
Methanol	757	11.81 @ 20°C	6	1.175	180	2,551[b]
AVERAGES	1,804		6.55	8.341	449	210[e]

[a]Prices from December 3, 1984, Chemical Marketing Reporter.
[b]Based on aluminum noncontact deck with liquid-mounted seal.
[c]Based on mild steel welded contact deck with liquid-mounted seal.
[d]Assumed product composition (1/3 each) crude methylene chloride, chloroform, carbon tetrachloride.
[e]Average cost effectiveness = $\frac{\Sigma \text{ net annual costs}}{\Sigma \text{ emission reduction}}$

to be $210/Mg. Although there are instances where the cost-effectiveness value is high, the average cost effectiveness of controlling constant level tanks is reasonable. These costs are also representative of production and process tanks that are operated typically as constant level tanks. Therefore, the final standards do not provide an exemption for constant level tanks.

2.1.3.7 Bulk Plant Storage Vessels

Comment: One commenter (IV-D-39) requested that the impact of the standards on small businesses be evaluated. The commenter was concerned that members of the Petroleum Marketers Association (particularly owners or operators of bulk gasoline plants) would be unable to raise the capital necessary to comply with the required controls.

Response: According to the Small Business Administration's criteria for small businesses, bulk plants may be classified as such because they typically have fewer than 500 employees. The economic impacts of the standards on model bulk plants were examined to see if adverse impacts (closure of the facility or inability to construct the new source) could be ruled out. While the capital costs of controls represent only 5 percent of total capital cost for a new model facility, the capital costs of control for replacing or adding an individual tank are significant and may be 50 percent of the total capital cost required to install a new individual tank. The bulk plant industry is declining due to competition from bulk terminals, withdrawal of major oil companies from the bulk plant business, and other reasons; and it is possible that the impact of further regulation would be to accelerate closures. Therefore, it was determined that a potential adverse economic impact exists.[17]

Although an Agency study indicates that the cost effectiveness of controls is reasonable for typical facilities ($520/Mg), the economic impact may not be reasonable.[18] The Agency was unable to quantify the profitability of bulk plant firms, and no data are available to prove that these firms have access to sufficient capital to install controls. Even firms that are part of integrated operations may not be able to divert capital from more profitable operations to bulk plant operations. Therefore, the Agency was unable to ascertain how many of the plants that would add or replace tanks would suffer an adverse economic impact due to

the inability to finance the capital costs of controls. Furthermore, bulk plants are an identifiable class of vessels and an exemption for this class would not affect the objectivity and enforceability of the standards. For these reasons, the Agency has decided to exempt bulk gasoline plants from the standards.

This change in the regulation from proposal only affects those plants in attainment areas. Plants located in nonattainment areas would have been exempted in any case because the control technology required by the SIP's in these areas (vapor balance systems) is incompatible with BDT. The bulk plant industry is also part of the gasoline marketing source category (Petroleum Transportation and Marketing [40 CFR 60.16]), and the decision whether to regulate emissions from these vessels at bulk plants is being made in a regulatory decision package for that category.

2.2 EMISSION CONTROL TECHNOLOGY

2.2.1 External Floating Roof Vessels (EFR's)

Comment: Two commenters (IV-D-18, IV-D-21) noted that hygroscopic VOL's cannot be stored in EFR's because of the potential contamination of the liquids by water.

Response: The Agency agrees that not every liquid covered by the standards is appropriate for storage in EFR's. Such liquids may be stored in internal floating roof vessels (ventilated or nonventilated) or in fixed roof tanks equipped with vapor recovery or disposal systems.

Comment: One commenter (IV-D-18) stated that industry experience with secondary seals is limited and that there is uncertainty regarding the effective life of the seals. The commenter also requested that EPA acknowledge a potential safety hazard from the formation of a vapor space between the primary and secondary seal.

Response: The commenter is correct in stating that there may be some uncertainty in the lifetime of secondary seals; the actual lifetime may be longer or shorter than the 10 years estimated at proposal. Comments received on the draft Control of Volatile Organic Compound Emissions from Volatile Organic Liquid Storage in Floating and Fixed Roof Tanks (CTG), August 1983, suggested that vapor-mounted primary seals on an internal floating roof would have a lifetime of 10 years or more in the more severe chemical services. Because the construction of the seal systems is

similar to that of secondary seals used on EFR's, it is reasonable to assume a 10-year life on secondary seals for EFR's as an average.

The Agency has determined that adequate technology exists and is commonly employed to operate EFR's with double seals in a safe manner. Although specific data are not available for EFR's equipped with double-seal systems, the fire and explosion hazard is greatly reduced by use of floating roofs in comparison to fixed roof tanks because the floating roof eliminates vapor space. The reduced hazard is substantiated by Factory Mutual Research fire loss experience for a 13-year period from 1962 to 1974.[5] Fixed roof tanks were involved in 53 percent of all losses while floating roof tanks were involved in only 34 percent. Significantly, 47 percent of fixed roof tanks were totally destroyed, and an additional 50 percent suffered major damage. Only 12 percent of floating roof tanks were totally destroyed, and 36 percent suffered roof, ring, or shell damage. Unlike fires in fixed roof tanks, most fires in floating roof tanks were extinguished by portable foam or water hose streams before serious damage occurred. Therefore, the Agency concludes that there are no safety hazards associated with floating roof tanks beyond those normally experienced by industry.

2.2.2 Internal Floating Roof Vessels (IFR's)

Commenters representing the chemical industry were concerned that IFR's and some liquid-mounted primary seals are not an appropriate or proven, safe control technology for the range of chemicals stored.

Comment: Three commenters (IV-D-9, IV-D-15, IV-D-22) noted that vented IFR's may not be the best choice of storage vessel in cases where the stored liquid must be protected from moisture or oxygen. One commenter (IV-D-22) cited chemical products such as chlorinated solvents that may be contaminated by exposure to moist ambient air. One commenter (IV-D-15) noted that vented IFR's would greatly enhance the cost of inert gas pads.

Response: These comments are based on the premise that the IFR required in § 60.112b(a)(1) must be vented. The Agency agrees that ventilating tanks storing liquids which must be protected from contact with ambient air is not wise. Neither the proposed nor the promulgated standards require the IFR to be vented. The IFR may be ventilated or

nonventilated, padded or unpadded, according to the preference of the owner or operator, without affecting the compliance status of the tank. Therefore, the requirement for an internal floating roof will impose no additional contamination problems, safety problems, or gas padding costs over normal industry practice. No changes to the standards have been made.

Comment: Three commenters (IV-D-9, IV-D-15, IV-D-22) stated that use of the floating roof itself is incompatible with storage of highly corrosive liquids. According to two of the commenters (IV-D-15, IV-D-22), to prevent corrosion damage, the vessel may either be lined with plastics, fluoropolymers, or synthetic materials, or it may be constructed with fiberglass reinforced plastic (FRP). These commenters state that such materials are unable to withstand the abrasion which is incipient in the operation of floating roofs. One commenter (IV-D-15) recommended that an alternate control technology be defined or that lined tanks be exempted.

Response: Regarding the abrasion of the tank liner, internal floating roof seals are typically made of soft materials and are softer than common liners. The seals do not exert much compressive force against the tank sidewall. The anticipated point of wear would be the seal and not the tank liner. Internal floating roofs have been installed in lined tanks and have operated properly without excessive wear to the liner.[19] Therefore, no exemption for lined tanks has been incorporated into the final standards.

Fiberglass reinforced plastic tanks are used by some tank operators to store corrosive liquids (chlorinated solvents, acids, and bases). These tanks are generally lined with a corrosion barrier composed of a thin layer of resin. Floating roofs are not used in these tanks because the roof seals could damage the resin layer such that a leak or structural damage results.[20] However, stainless steel tanks equipped with internal floating roofs may be substituted for FRP tanks, or emissions from FRP tanks may be controlled by use of a closed vent system and 95 percent effective control device. Therefore, because adequate control alternatives are available to owners or operators of FRP tanks, no revisions have been made to the standards.

Comment: One commenter (IV-D-9) questioned whether ventilation in IFR's is adequate to prevent an explosion hazard. Another commenter (IV-D-21) said that the proposed standards should recognize that the use of IFR's could promote the formation of explosive vapor mixtures above the floating roof. Another commenter (IV-D-22) noted that, by design, the product stored in an IFR is isolated from any roof-mounted deluge system, thus reducing the probability of early control of any fire that occurs.

Response: The Agency has determined that the proposed standards do not pose a safety hazard. A representative of the Texas Chemical Council (IV-D-9) has stated that his company's (E. I. Dupont) safety personnel had reviewed the proposed standards and did not believe that the required controls would pose a hazard. Data from vendors indicate that the lower explosive limit was never reached in tests on a noncontact internal floating roof in vented tanks storing a wide variety of products.[21] It appears that there are no additional safety hazardous associated with the IFR beyond those hazards normally accepted by the industry.

As stated previously, there is no requirement that IFR's be vented. Vessels equipped with internal floating roofs may be vented or nonvented and blanketed or unblanketed.

Regarding isolation from any roof-mounted deluge system, vendors of internal floating roofs and Factory Mutual Research Standards have stated that foam distribution systems have been used successfully against fires in internal floating roof tanks.[5] Foaming the deck closes off the oxygen supply so that any vapor space under the deck will quickly be deficient in the oxygen necessary to support a fire.

Comment: One commenter (IV-D-9) questioned the accuracy of the API emission equations for IFR's. The commenter discussed the accuracy of the equations when applied to vented vessels smaller than 20 feet in diameter, which are more common in the chemical industry. The commenter said that the equations were more accurate for the larger vessels typically found in the petroleum industry. The commenter requested that EPA consider the nonvented IFR because the wind speed, which affects the air flow pattern through the vents, would not be a factor, and emissions should be reduced.

Response: Overall, the emission test data on IFR's indicate that there is no significant dependence on wind speed. Wind-induced ventilation removes vapors that have already escaped the space confined by the deck, seals, or fitting covers, and it does not appear to cause these emissions. It is expected that the different ventilation patterns in smaller tanks would not play a significant role in generating emissions especially if vapor space is minimized by employing liquid-mounted seals or pressure differentials are prevented by using tight fitting vapor-mounted primary seals and secondary seals. Therefore, EPA believes that the current emission equations are adequate to support the selection of BDT for both small and large tanks.

2.2.3 Add-on Control Options

Comment: Two commenters (IV-D-13, IV-D-22) discussed alternate control options. One commenter (IV-D-13) asked if use of control devices such as carbon adsorption, refrigerated condensers, and thermal oxidizers are allowed if they achieve 95 percent emission reductions. Another commenter (IV-D-22) noted that an alternate control option, vent gas condensation, is commonly used and that its efficiency may be enhanced through the use of product cooling and tank insulation. The commenter requested that EPA consider allowing this control option.

Response: Any type of closed vent system and control device such as a carbon adsorber, vent gas condenser, or thermal oxidation unit that is designed and operated to reduce inlet VOC emissions by 95 percent or greater is in compliance with § 60.112b.

Product cooling and tank insulation could be used to enhance the effectiveness of condensation systems. The standards are based on the vapor pressure of the liquid at its storage temperature. Therefore, the use of this strategy is not prohibited by the standards.

Comment: One commenter (IV-D-9) requested that EPA allow use of pressure/vacuum (conservation) vents. The commenter said that in vessels with zero turnovers, a conservation vent is more effective than a vented IFR. Another commenter (IV-D-22) stated that conservation vents, coupled with tank insulation and product cooling, provide a reasonable level of control in many circumstances.

Response: Conservation vents may have some effect in controlling breathing losses from fixed roof vessels. However, the ability of a conservation vent to reduce emissions in the chemical and petroleum liquid industries is not well established. Additionally, VOC emissions due to working losses significantly outweigh emissions due to breathing losses, particularly as the number of tank turnovers increases.

As an example, the model tank used in the Volume I BID (volume of 606 m^3 [160,000 gal], diameter of 9.1 meters [30 ft], 50 turnovers per year, vapor pressure of 6.9 kPa [1 psia], and molecular weight of 80) has total emissions of 6.22 Mg/yr as a fixed roof tank. Only 0.88 Mg/yr result from breathing losses. Therefore, if a conservation vent reduced breathing losses to zero, the emission reduction would total about 14 percent. This is in sharp contrast to the 96-percent reduction obtained by equipping the tank with an internal floating roof.[1]

The scenario of zero turnovers presented by the commenter is unrealistic. Tanks are not permanent storage facilities for chemical products and, therefore, do not have zero throughput. Tanks in the chemical industry average about 60 turnovers per year in the 600 m^3 (160,000 gal) size range and about 150 turnovers in the 151 m^3 (40,000 gal) size range. Therefore, the final standard does not allow the use of conservation vents in lieu of the specified controls.

The combination of conservation vents and product cooling might be, in specific instances, approved by EPA as an alternative means of emission limitation under § 60.114b. However, it would be the obligation of the applicant to demonstrate that the proposed controls are equivalent to those promulgated in § 60.112b.

The test program that is currently being conducted by API will examine the emission equations for fixed roof vessels. The results of this test program will be used to evaluate the potential contribution of conservation vents to an emission reduction program in the next review of the standards and may be useful in supporting an application under § 60.114b.

Comment: One commenter (IV-D-23) discussed the fugitive emission monitoring requirement for closed vent systems. The commenter questioned the cost effectiveness of the fugitive emission requirement for two

reasons: (1) the fugitive emission level is low and (2) a product recovery credit cannot be claimed because the "recovered" material ends up in the waste stream. The commenter requested that all references to fugitive emission monitoring be reevaluated for their cost effectiveness.

If the requirement for control of fugitive emissions from a closed vent system is retained in the standard, the commenter recommended the following:

1. Fugitive emission control should be limited to a new, modified, or reconstructed closed vent system. The commenter noted circumstances in which a new, modified, or reconstructed storage vessel may have emissions controlled by an existing closed vent system that also controls other existing sources. The commenter stated his belief that it is not the intent of EPA to apply the standards to an existing facility of this type.

2. The requirement referred to as the SOCMI equipment leak standard, 40 CFR Part 60, Subpart VV, § 60.485(b), should be subject to all the limitations and exceptions contained in Subpart VV.

3. The commenter noted that the VOL standards are more restrictive than the SOCMI standards with respect to leaks from valves and pumps. The commenter said that the 500 ppm cutoff in the proposed standards is more restrictive than the 10,000 ppm cutoff in the SOCMI standards. The commenter requested that a 10,000 ppm cutoff be adopted for valves and pumps in the proposed VOL standards to maintain consistency with the SOCMI standards.

Another commenter (IV-D-13) requested further information on the basis for using 500 ppm above background as the level of no detectable emissions for closed vent systems. The commenter questioned whether readings at this level are consistent with current instrument capabilities and whether the requirement is consistent with leak rates set under fugitive emission rates.

Response: The commenter (IV-D-23) misunderstood the intent of the fugitive emission requirement in Subpart Kb. The requirement is not intended to control fugitive emissions but rather to ensure that an alternative to BDT is operated effectively. The only adopted provision of Subpart VV is the no detectable emissions limit. Valves and pumps are not covered by Subpart Kb.

The commenter (IV-D-23) questioned the applicability of the fugitive emission requirement in circumstances where a new, modified, or reconstructed storage vessel is controlled by an existing closed vent system and control device. If the owner or operator chooses to control a new source through the use of a closed vent system and control device, the control equipment must be operated and maintained to conform to the requirements of the standards. In this case, these requirements include meeting the fugitive emission leak standards as specified in § 60.112b(a)(3)(i). A new fixed roof storage vessel is not considered to be in compliance with these standards when it is linked to an existing closed vent system and control device unless the existing equipment is in compliance with § 60.112b(a)(3)(i). Therefore, the Agency has determined that no changes are necessary in the final standards.

The comment that a 500 ppm above background cutoff for allowable detectable emissions is more restrictive than the cutoff level allowed under the SOCMI standards is erroneous. The SOCMI standards require that closed vent systems shall be designed and operated with no detectable emissions indicated by an instrument reading of less than 500 ppm above background and visual inspections. This is the provision adopted under Subpart Kb. The 10,000 ppm cutoff referred to by the commenter only applies to the requirements in the SOCMI standards for valves and pumps. This cutoff is not applicable to Subpart Kb. The Agency has determined that adequate instrumentation exists to determine emissions below 500 ppm.

Comment: One commenter (IV-D-9) recommended modification of the requirement for a 95 percent reduction in emissions when a closed vent system and control device are used. The commenter recommended that, in circumstances where vented IFR's cannot be used, the control device should instead be designed and operated to achieve an emission reduction equivalent to that calculated for the affected storage vessels by the formulas in AP-42 and API Bulletin No. 2519 or by a reduction of 95 percent, whichever is lower.

Response: The three fundamentally different techniques for compliance allowed by these standards are not equivalent in terms of emission rate. In the process of developing the requirements for internal floating roofs, each component of the roof was evaluated for emission reduction and

cost. Thus, a BDT for internal floating roofs was developed. The calculated emission reduction obtained by a BDT internal floating roof varies from about 50 percent up to 99 percent over a fixed roof tank depending on the number of turnovers, vapor pressure, and molecular weight of the stored material. The reduction obtained in typical tanks is about 95 percent.

Properly designed and operated vapor control systems can reduce VOC emissions by 95 percent. This is similar to the reduction typically achieved by the BDT internal floating roof. If vapor recovery systems are to be used, they should be designed and operated to be as efficient as possible. Installation of vapor control systems designed to function at low efficiencies would increase emissions unnecessarily. Therefore, the final standards do not incorporate the provision requested by the commenter.

Comment: While one commenter (IV-D-2) stated support for the use of flares as a control device, three other commenters (IV-D-6, IV-D-9, IV-D-12) stated that the flare exit velocity limitations are unduly restrictive and suggested that they be reviewed in light of the latest information from the Chemical Manufacturers Association (CMA) and EPA. Two commenters (IV-D-9, IV-D-12) said that the velocity specifications are identical to those proposed in the SOCMI equipment leak NSPS and suggested that both the SOCMI and the proposed VOL standards be revised to encompass a consistent set of limitations based on a recently completed study showing 98 percent or better destruction efficiencies at velocities greater than the existing velocity limitation. One commenter (IV-D-9) suggested a public comment period on flare operation limitations.

Response: The flare exit velocity limitations have been reviewed by EPA in the time since the standards were proposed. New data obtained by an EPA test program showed that VOC destruction efficiencies of 98 percent or better are achievable using higher exit velocities when the net heating value of the gas being combusted is greater than 37.3 MJ/scm (1,000 Btu/scf). In order to avoid having a large number of regulations with indentical flare specifications, the Agency has promulgated the addition of uniform flare specifications to § 60.18 of the General Provisions (51 FR 2699, January 21, 1986). The VOL standards have been

revised to incorporate these provisions as well. The specifications limit flare exit velocity of steam-assisted and nonassisted flares to 18.3 m/s (60 ft/s) unless the net heating value of the gas being combusted is greater than 37.3 MJ/scm (1,000 Btu/scf). In this latter case, exit velocities may be between 18.3 m/s and 122 m/s (400 ft/s). The specifications also permit the owners to operate the flare at a prorated maximum exit velocity (based on the net heating value of the gas being combusted) so long as it is less than 122 m/s (400 ft/s) but greater than 18.3 m/s (50 ft/s).

2.2.4 Column Fittings

Comment: Three commenters (IV-D-7, IV-D-8, IV-D-20) found the required use of flexible fabric sleeve seals on column penetrations to be restrictive and recommended that EPA also allow the use of gasketed sliding covers. They noted that flexible fabric sleeve seals are a fitting design unique to a single manufacturer and are not generally available. They also noted an insignificant difference in overall emission reduction (0.1 to 0.2 percent) when flexible fabric sleeve seals are used in place of gasketed sliding covers. Two of the commenters (IV-D-7, IV-D-8) stated that the use of "built-up" columns, which are currently in wide-spread use, is disallowed under the proposed standards because sleeve seals can only be used with pipe columns. One commenter (IV-D-20) discussed the potential for damage and maintenance repair problems with use of sleeve seals which could result in lengthy downtime.

One commenter (IV-D-7) pointed to an apparent miscalculation in the BID resulting in a 50-percent overestimation in the emission reduction associated with controlled versus uncontrolled fittings. According to the commenter, a miscalculation would place an undue emphasis on maximizing fitting controls and, therefore, would restrict column and seal designs that should be allowable.

Two commenters (IV-D-7, IV-D-18) said that slotted gauge/sample poles are frequently used and recommended that they be allowed in the final rule.

Response: Flexible fabric sleeve seals are currently available only on contact decks. It is not the intent of the Agency to prohibit the use of noncontact decks with this fitting requirement. While the annualized

cost of redesigning a noncontact deck to allow the adoption of flexible fabric sleeve seals is not known, the Agency has determined that it is highly unlikely that noncontact decks could be redesigned and flexible fabric sleeve seals installed cost effectively. Alternatively, gasketed sliding covers are widely available and may be employed on both contact and noncontact decks. Therefore, the Agency has decided to revise the proposed regulations to allow the use of either flexible fabric sleeve seals or gasketed sliding covers.[22]

The EPA has reevaluated the costs to control emissions from fittings. These controls are estimated to cost $500 (4 percent of the cost of the deck) for a typical vessel with a diameter of 9.1 m (30 ft). The cost effectiveness of controlling emissions from fittings on this vessel storing a typical VOL is $990/Mg. The capital cost of controlling fitting emissions on a typical 30.5-m (100-ft) diameter vessel storing gasoline is $1,677, and the cost effectiveness is $330/Mg.[22] The Agency has determined that these values are reasonable, and, therefore, no changes have been made to the requirements for fitting controls.

The standards will not be revised to allow the use of slotted gauge/sample poles. The BDT for sample pipes and wells is the slit fabric seal with 10 percent open area. Slit fabric seals are widely available at no additional cost and achieve a greater emission reduction than slotted gauge/sample poles and are included in the above evaluation.

2.2.5 Alternative Means of Emission Limitation

Comment: Two commenters noted the possibility of construction delays resulting from EPA granting permission to use technology that is equivalent to the technologies allowed in the proposed standards. One commenter (IV-D-7) requested that EPA be required to grant permission within 90 days of receipt of a request rather than allowing the unspecified period in the proposed standards. A second commenter (IV-D-22) requested that State agencies operating with approved State Implementation Plans be allowed to grant permission.

Response: No changes will be made in the language regarding alternative means of emission limitation. This NSPS is an equipment standard (§ 111(h) of the Clean Air Act) because it is impracticable to measure emissions. Any future requests for permission would most likely

be made for a new type of roof or seal. A straightforward emissions measurement is not possible in these cases; and it is likely that the determination could involve complex modeling, the evaluation of new test methodologies, or other time consuming tasks. A 90-day time period is not sufficient to evaluate the proposed equipment, provide notice and opportunity for a hearing, and publish a decision. The amount of time needed to make a determination can vary greatly depending on the complexity of the application. Therefore, the time in which the Agency is to grant permission is left unspecified in the final standards.

No changes have been made in the standards to allow the States to grant permission. Even when States have been delegated NSPS authority, they have not been delegated the authority to grant permission. The reason for this policy is that different States could come to opposite conclusions on the equivalency of a new technology. This would be both confusing and contrary to the need for uniform, national performance standards for new sources.

2.3 RECORDKEEPING, REPORTING, AND INSPECTION REQUIREMENTS

2.3.1 Recordkeeping and Reporting Requirements

Comment: Several commenters requested changes in the provisions requiring operators to maintain records showing the dimensions and capacity of storage vessels larger than or equal to 40 m^3 (10,000 gal). Four commenters (IV-D-2, IV-D-10, IV-D-16, IV-D-39) said that the recordkeeping provision is without purpose or benefit because vessels that are less than 75 m^3 (20,000 gal) are not subject to the control requirements. One commenter (IV-D-10) said that the inclusion of any sort of requirement on vessels down to 40 m^3 in capacity would generate both demand for performance standards for these vessels and more permitting requirements at the State or local level. One commenter (IV-D-4) suggested that the regulation only apply to storage vessels with a capacity greater than 70 m^3 (18,500 gal), while three others (IV-D-10, IV-D-16, IV-D-39) suggested that the cutoff for recordkeeping and control be the same level (75 m^3 [20,000 gal]).

Response: The Agency has required the owner/operator of tanks between 40 m^3 and 75 m^3 (10,000 gal and 20,000 gal) to retain a record of the size of the tank to aid in enforcement of the standards. The records

are necessary for enforcement because they remove any ambiguity in identifying vessels that are close to the control cutoff. According to one commenter (IV-D-10), the recordkeeping requirement is not burdensome because such records are routinely maintained. The EPA judges that it should not refrain from adopting appropriate requirements because of speculation that they may inspire further regulation.

Comment: One commenter (IV-D-13) stated that the reporting requirements are burdensome and time consuming for both the regulated community and the Agency. The commenter recommended that the reporting requirements be replaced with a requirement that the regulated community maintain reasonable records of performance.

Response: The Agency has determined that the reporting requirements are reasonable and do not place an undue burden on the regulated community or the Agency. Reports are submitted only in the event of a system failure and, given the expected low probability of system failure, the reports will not be an undue burden. The reporting requirement is essential in enforcing the standards.

Comment: One commenter (IV-D-23) said that the requirement that an operator of a vessel equipped with a closed vent system (other than a flare) submit an operating plan for approval to the Administrator is burdensome. The commenter noted that under the General Provisions (§ 60.8), a performance test is already required within 60 to 180 days of start-up to verify the efficiency of the system. The commenter said that the testing requirement alone should be sufficient to demonstrate compliance and that submittal of an operating plan for approval should not be required.

Response: It was not the intent of the Agency to require a performance test for these standards. Emissions from fixed roof tanks are variable and are often at rates that are too low to measure. When liquid is entering a vessel, the liquid surface rises, forcing vapors above the liquid surface out of the vessel. While this is occurring, the vapor flow rate and the emissions are large. When liquid is exiting the vessel, the liquid surface falls, and the resulting pressure differential sucks air or a blanketing material into the vessel. During these operations, vapor flows into the storage vessel and results in no atmospheric emissions.

When the liquid level is held constant, pressure differentials resulting from diurnal temperature variations expel vapors at very low flow rates at intermittent times during the cycle.

Certain components of uncontrolled emissions have been measured in very specialized tests conducted by EPA and industry. Total emissions have not been measured, however, and to do so would require that the operation of the vessel be strictly controlled during the testing period. Because of methodology problems, it may not be possible to measure both the flow rate and the concentration simultaneously. This would cast doubt on the accuracy of the measurement. In any case, testing would be extremely expensive for individual compliance determinations. For these reasons, it was concluded that it was impracticable to measure the emissions exiting the tank.

For the same reasons, it would be impracticable to measure the emissions captured by the closed vent system or entering the control device. Therefore, it was concluded that reduction efficiency measurements are not feasible for closed vent systems and control devices, and the format of the standards for closed vent systems and control devices is an equipment standard. Therefore, no performance test is required.

Inspection, maintenance, and repair requirements are necessary to ensure the proper operation and integrity of control equipment meeting the standards. Submittal of an operating plan is essential to demonstrate compliance with the standards, and the requirement has been retained in the final standards. The requirement will be modified, however, to specifically exempt storage vessels from the General Provision requirement for a performance test (§ 60.8) for the reasons discussed above.

2.3.2 External Floating Roof Vessel (EFR) Inspection Requirements

Comment: One commenter (IV-D-11) said that annual measurements of secondary seal gaps on EFR's are excessive and that these measurements should be conducted every 5 years to coincide with measurement of the primary seal gap.

Response: The time and resources required to conduct these inspections are minimal. The only way to ensure seal integrity and compliance with the standards is through these inspections. Therefore, the annual inspection requirement has been retained in the final standards.

Comment: Two commenters (IV-D-7, IV-D-18) requested that EPA allow the initial seal gap measurements to occur during the hydrostatic testing of the vessels or within 60 days (IV-D-7) or 6 months (IV-D-18) of the initial fill.

Response: The Agency has revised the final standards to allow the seal gap measurements to occur during hydrostatic testing. Measurements conducted during the hydrostatic testing would reveal any seal gaps that would be discovered during an inspection after the initial fill. The 60-day time frame to conduct the inspection after the initial fill is reasonable considering that the inspection takes less than a day. Therefore, the time frame after the initial fill has not been changed from the proposed standards.

2.3.3 Internal Floating Roof Vessel (IFR) Inspection Requirements

2.3.3.1 Annual Visual Inspection.

Comment: One commenter (IV-D-9) said that an annual visual inspection of IFR seals precludes the use of nonvented IFR's because of the excessive time, materials, and manpower required to inspect the vessels. The commenter said that the inspection would also violate internal company safety rules. The commenter suggested that IFR's with primary and secondary seals be inspected internally at 5-year intervals. If EPA were to approve a 5-year inspection interval, the commenter further proposed that it be considered equivalent to an annual inspection of a single-seal system. The commenter calculated that overall emission rates due to seal failure are equivalent under the two options.

Response: After evaluating this issue, the Agency has determined that it may not be possible to inspect all IFR's without emptying and degassing the vessel.[23] The Agency evaluated the commenter's proposed revision and has decided to revise the standards. If the operator equips the vessel with a primary and a secondary seal and conducts an internal inspection every 5 years, the controls are considered equivalent to a single-seal system and annual visual inspection. Under the double-seal system option, the addition of a secondary seal will reduce emissions beyond the emission reduction achieved by a single-seal system, thus offsetting the risk of increased emissions due to seal failure. In any case, seal failure rates are generally quite low, and a major failure

(such as a deck sinking) would be evident to the operator even in the absence of an annual inspection because of a loss of material.

A worst-case analysis of the possible impact this suggestion would have on emissions was performed. Even if 10 percent of the tanks equipped with primary and secondary seals experienced total failure of one seal, average emissions would be 4 percent lower than if all tanks had been equipped with a primary seal only.

Comment: Three commenters (IV-D-9, IV-D-15, IV-D-17) discussed a potential safety hazard in conducting an annual visual inspection in all IFR's. Two commenters (IV-D-15, IV-D-17) suggested as an alternative to the inspection requirement that VOC emissions be monitored annually from a small fitting on the roof. They said that if monitoring indicates a significant increase in emissions, an internal inspection would be warranted to find and correct the problem. One commenter (IV-D-17) suggested that this alternative replace the annual visual inspection while the other commenter (IV-D-15) suggested that it be considered equivalent to the visual inspection. Another commenter (IV-D-12) recommended that, where safety problems can be caused by the requirements of an annual visual inspection, visual inspection should be required when degassing occurs or at intervals not greater than 10 years.

Response: The Agency agrees that in particular tanks, the annual visual inspection may pose a problem. Therefore, as noted in the previous response, the requirement has been altered. Because tanks in the chemical industry are typically cleaned and degassed once every 5 years under current practices, the revised requirements will alleviate any safety problem with the annual visual inspection.

The alternative suggested by the commenters has not been incorporated into the final standards. There are no data on which to select a hydrocarbon concentration that would indicate a problem with the control equipment. The hydrocarbon concentration measured at the roof fitting would be heavily dependent upon recent tank operations (e.g., filling, emptying, or static level) and liquid level. The Agency is not aware of any method by which an annual concentration measurement could be used to establish the condition of the control equipment.

Comment: One commenter (IV-D-9) said that the time (1 hour) estimated for the annual inspection is greatly underestimated. The commenter requested a reference for the estimate.

Response: Based on site visits by EPA personnel, the Agency determined that 1 hour is a reasonable estimate for the time required to conduct an annual visual inspection; therefore, the costs based on the time estimate will not be changed. Personnel from the Texas Air Control Board said that the inspection takes 4 hours, which includes time for a file search and time for writing the report.[23] However, even using the 4-hour estimate, the cost of the annual inspection is not burdensome.

2.3.3.2 Ten-Year Inspection.

Comment: Three commenters (IV-D-7, IV-D-20, IV-D-39) said that the requirement that IFR's be emptied and degassed at least once every 10 years is unreasonable for facilities with only one IFR or where acceptable alternate tankage is not available. One commenter (IV-D-7) requested that pipeline tank stations with only one IFR be exempt from these requirements or that an operationally compatible method to empty and degas the tanks be allowed.

Response: As stated in the previous response, tanks in the chemical industry are typically emptied, degassed, and cleaned every 5 years. Benzene storage vessels are typically emptied, degassed, and cleaned on 10-year intervals. The Agency has determined that it is typical industry practice to clean tanks on a regular basis and that the 10-year internal inspection requirement is not an undue burden. The Agency has determined that no special provisions are necessary for pipeline tanks. In many instances, alternate tankage such as an EFR will likely be available. In any case, it is not unreasonable to require a facility with only one IFR to conduct a planned, internal inspection every 10 years. Further discussion with one of the commenters (IV-D-7) revealed that existing tanks were of concern.[24] This NSPS will not affect existing storage vessels; therefore, no changes have been made as a result of these comments.

2.3.4 Procedures for Vessels Found to be Out of Compliance

Comment: Several commenters said that the 30-day allowance for repairing or emptying storage vessels found to be out of compliance is unreasonable. Two commenters (IV-D-20, IV-D-39) said that the provision would necessitate the installation of two small tanks rather than a single large tank to provide the flexibility to transfer material from a vessel in need of repair. One commenter (IV-D-39) noted that the 30-day allowance would be a problem at facilities with only four or five tanks because alternate tankage might not be available. Another commenter (IV-D-5) noted that the provision would be a problem in the event a facility found that several vessels were simultaneously out of compliance. One commenter (IV-D-19) suggested that a 45-day allowance would give the operator sufficient time to order, receive, and install new equipment without having to request an extension. Four other commenters (IV-D-6, IV-D-7, IV-D-12, IV-D-20) suggested a 90-day allowance as a reasonable time to repair a vessel or remove it from service. One commenter (IV-D-39) proposed a 120-day allowance.

Response: Discussion with storage vessel manufacturers indicated that a 30-day allowance for repairing storage vessels in conjunction with the option of requesting a 30-day extension is reasonable from the supplier's viewpoint. However, in the event that special materials not normally kept in stock (such as Teflon® seals) were required, this time would probably be insufficient.[25,26] The Agency has decided to revise the proposed standards to provide a 45-day allowance to accommodate delays in repairing or emptying the storage vessel. A 30-day extension may still be requested if repairs are likely to exceed the initial allowance.

2.3.5 Notification of Refill

Comment: Three commenters (IV-D-19, IV-D-23, IV-D-39) said that the requirement to notify EPA 30 days prior to refilling storage vessels after conducting a planned inspection is unnecessary and may delay the refilling of needed storage capacity. Two commenters (IV-D-19, IV-D-39) said that inspection prior to refilling should be a recordkeeping function. Another commenter (IV-D-5) stated that the intent of the requirement was to provide 30 days' notice to EPA prior to refilling the vessels. Two commenters (IV-D-5, IV-D-23) suggested that the 30-day notification period begin prior to the inspection.

Response: The requirement is intended to provide 30 days' notice to EPA prior to refilling the vessels and not to delay the start of the notification period until after the vessel has been emptied. The requirement has been revised to allow the notification period to begin prior to emptying and inspecting the storage vessel.

Comment: Two commenters (IV-D-22, IV-D-23) discussed the 7-day notification period in the event of an unplanned inspection. One commenter (IV-D-22) said there would be the possibility of excessive downtime and recommended that this requirement be deleted. If it is retained, the commenter suggested a 2- to 3-day notification period. The commenter also said that EPA should be required to provide a telephone contact on weekends and holidays to enable the period to begin at any time. The other commenter (IV-D-23) noted the possible delay in returning to normal operation resulting from the 7-day requirement and suggested shortening the notification period to 8 business hours in the event of an unplanned inspection.

Response: The Agency has determined that a 7-day notification period in the event of an unplanned inspection is reasonable. Discussions with a representative of a tank service company revealed that it takes from 2 days to 2 weeks to empty, degas, clean, and inspect a tank.[25] Factors such as increasing tank size, heavy sludge deposits, worker and equipment access to the tanks, and the need to replace seals can all increase the length of time needed beyond the minimum to perform the work. The ability of the service company to respond rapidly to an emergency call depends on the availability of workers and equipment. Therefore, the Agency has decided that a 7-day notification period will not result in excessive downtime throughout the industry. Furthermore, the 7-day period is necessary from the Agency's perspective to allow adequate time for the mobilization of the necessary manpower and resources to inspect the vessel. For example, 2 to 3 days are often required to receive approval for travel, and additional time is required to make travel arrangements. Inspections are often coordinated with State and local agency personnel, and time is required to coordinate schedules. In the event the owner/operator makes the Agency aware of a special problem on a vessel requiring immediate refill, the Agency will make every effort to respond as quickly as possible.

2.4 MODIFICATION

Comment: Six commenters (IV-D-2, IV-D-13, IV-D-18, IV-D-22, IV-D-23, IV-D-39) requested clarification of the modification provision. The commenters suggested excluding the changing of liquids in storage vessels from constituting a modification if the existing facility was originally designed to accommodate the alternate liquids. Three commenters (IV-D-18, IV-D-22, IV-D-39) suggested that this be accomplished by exempting as affected facilities vessels meeting these conditions. One commenter (IV-D-13) suggested the proposed standards clearly state that little can be done to a storage vessel to qualify as a modification.

Response: The commenters are correct that a change of the stored liquid in and of itself will not be a modification to an existing vessel. If a vessel constructed prior to July 23, 1984 (date of proposal of these standards), were storing a non-VOL or a VOL with a vapor pressure below the cutoffs (5.2 kPa [0.75 psia] for tanks with capacities greater than 151 m^3 [40,000 gal] and 27.6 kPa [4 psia] for tanks with capacities equal to or greater than 75 m^3 [20,000 gal] but less than 151 m^3 [40,000 gal]) and the vessel contents were changed to an affected VOL, the vessel would not be considered an affected facility under Subpart Kb if the existing facility had been designed to accommodate the new liquid. However, if a vessel constructed after proposal undergoes a similar change, the vessel could fall under the control requirement provisions of Subpart Kb. Because this distinction is clear in § 60.14 of the General Provisions, no changes are incorporated into the final rule.

Comment: One commenter (IV-D-22) suggested that vessels that suffer from catastrophic failure should be exempt from the proposed standards if they are reconstructed "in-kind" and preexisting controls achieved at least an 85 percent emission reduction. The commenter also stated that existing vessels that are modified should be exempt if they are operated with controls that are at least 85 percent efficient.

Response: The provisions for modification and reconstruction are clearly defined by §§ 60.14 and 60.15 of the General Provisions. They do not allow "in-kind" reconstruction or modification, even in the event of a catastrophic failure. The intent of Section 111 of the Clean Air Act is to reduce emissions as older facilities are modified or replaced with new

facilities by requiring that the modified or new facilities meet the NSPS. In the case of facilities that are not completely new, the Agency has made provisions that reconstructed facilities will also be required to meet the NSPS. An allowance for "in-kind" replacement would be inconsistent with the Act's intent. Additionally, the cost effectiveness of controls for a modified or reconstructed facility would be comparable to that of a new facility. This cost effectiveness is reasonable (a net credit on average). Therefore, the proposed standards have not been revised as the commenter suggests.

2.5 COST EFFECTIVENESS

2.5.1 Capital Recovery Factor

Comment: One commenter (IV-D-8) stated that the capital recovery factors used in the cost analysis are not representative of the ones used in the petroleum industry. According to the commenter, the analysis should have been based on "equity financing" rather than "debt financing." The commenter said that the use of equity financing would double the capital recovery factors and increase the costs of the control options.

Response: Capital recovery factors for regulatory cost and cost-effectiveness analyses are traditionally based upon a 10-percent real interest rate and the physical lifetimes of control equipment. Such estimates are intended to reflect the cost of regulation to society.

As noted in Chapter 9 of the Volume I BID, industry financial characteristics were considered in the economic impact analysis through the calculation of an industry-specific cost of capital, which incorporates all types of financing. This cost of capital estimate is an average of the costs of debt, equity, and preferred stock, weighted by the percentage of funds generated by each type of financing. The cost of capital estimate was based on a sample of 100 firms, some of which were petroleum companies. The cost of capital estimate reflects the types of financing employed by both firms that operate primarily in the chemical industry and firms that operate primarily in the petroleum industry.

2.5.2 Product Recovery

Comment: Three commenters questioned the product recovery credits used in the analysis. One commenter (IV-D-8) said that the assumed product value is about double the product value commonly assumed in the

petroleum industry. The commenter concluded that the economic analysis overstates the credit for product recovery and makes the cost-effectiveness values for controls on the petroleum industry appear more attractive than they really are.

Another commenter (IV-D-15) requested that the choice of product recovery values be clarified. The commenter noted that values of $360/Mg ($400/ton) and $695/Mg ($770/ton) were noted in the preamble to the proposed standards while values of $460/Mg ($510/ton) were used in the Volume I BID.

A third commenter (IV-D-18) said that no product recovery credit is available to the "for-hire" terminals.

Response: The Agency reexamined the cost-effectiveness values for controls on petroleum liquid storage vessels. A lower product value, $220/Mg, was assumed. Based on information developed for the draft Control Techniques Guideline document, this product value is reasonable. The cost effectiveness of a typical petroleum liquid storage vessel (30 m^3 [100 ft] in diameter) was calculated for a low vapor pressure crude oil and for a higher vapor pressure gasoline.[1] Assuming 12 turnovers per year on the crude vessel, the cost effectiveness is $824/Mg. The cost effectiveness on the gasoline storage vessel is $1,149/Mg at 12 turnovers per year. The cost effectiveness of control of these vessels is considered reasonable even when a lower product value is assumed.

The product values in the preamble reflect a worst-case cost ($360/Mg) for chemicals and an average price ($695/Mg) of chemicals between 3.5 and 10.4 kPa (0.5 and 1.5 psia), respectively. These prices were used to set the control cutoffs ($360/Mg) and to evaluate the impacts of the standards on a typical tank storing a low pressure liquid ($695/Mg). The value in the Volume I BID ($460/Mg) represents a nationwide average of retail prices of high volume chemicals and was used to evaluate the overall impacts of the standards on the chemical industry. All product recovery credits are expressed in 1982 dollars.

While a direct product recovery credit is not available at "for hire" terminals, an indirect credit is available because less product is lost as the result of emission controls, and the company can reasonably charge more for storage in the tanks that have fewer losses.

Comment: One commenter (IV-D-15) stated that the cost calculations show that as larger vessels are considered, the product recovery credit becomes greater than the cost of control. The commenter questioned whether the proposed standards are necessary in this case.

Response: In some cases, the cost of controlling VOC emissions yields a net credit because of the value of the recovered product, and, in such cases, industry may adopt the control independent of any regulation. However, there is no assurance or experience to show that this will occur. There are other cases where control of storage vessels, while cost effective, has a net cost to the owner. In these cases, in the absence of an NSPS, BDT would probably not be installed by the facility. In addition, it may be possible to install control technology that would yield a net credit to the owner but would not be as efficient as BDT. This would occur where the overall cost is a credit and where there is an incremental cost between the differing levels of control. In such situations, an NSPS is necessary to ensure that BDT is installed in all cases. Even when the BDT is installed, the NSPS ensures proper operation and maintenance of the equipment and, thus, the maximum emission reduction. For these reasons and in order to implement uniform, nationwide standards, the Agency has decided to apply the NSPS to all affected facilities.

2.5.3 Cost of Controls (Cost Effectiveness)

2.5.3.1 Add-On Controls.

Comment: One commenter (IV-D-2) stated that control of a 151-m^3 (40,000-gal) vessel storing liquid with a vapor pressure of 3.5 kPa (0.51 psia) would have an unreasonable cost effectiveness of at least $8,800/Mg if the VOC's were ducted to an existing control device. The commenter noted that if the costs of a new control device were considered, the cost-effectiveness value would likely be an order of magnitude higher. Another commenter (IV-D-5) said that no consideration was given to the incremental cost of utilizing carbon adsorption, incineration, or other similar control devices when considering individual vessels.

Response: As discussed earlier, the vapor pressure cutoff has been changed from 3.5 to 5.2 kPa (0.51 to 0.75 psia). In any case, the owner/operator does not have to install a closed vent system and control

device. Internal floating roofs can be built at a reasonable cost and are applicable to a wide variety of storage situations. These are the reasons this technology was selected as BDT. For example, the cost effectiveness of using an internal floating roof to control the tank described by the commenter (151 m^3 [40,000 gal] in capacity and storing a liquid with a vapor pressure of 3.5 kPa [0.51 psia]) is $1,940/Mg, assuming 50 turnovers/year and a product value of $460/Mg. The cost of controlling the same tank storing liquid with a vapor pressure of 5.2 kPa (0.75 psia) and a lower product value ($360/Mg) is only $1,290/Mg.[27] However, these standards allow the owner or operator to control emissions with a closed vent system and control device that is 95 percent efficient because these controls achieve the same emission reduction as BDT. As noted in previous responses, these systems are also widely used and achieve a reasonable cost effectiveness for small tanks storing high pressure liquids or on a plant-wide basis.

2.5.3.2 Floating Roof Vessels.

Comment: One commenter (IV-D-7) questioned the assumption that controlled fittings costs are negligible.

Response: The Agency agrees that the cost of the control requirements for fittings is greater than zero but still maintains that it is small in comparison to the overall cost of the IFR. Estimates from vendors indicate that controlled fittings increase the installed capital cost of the IFR between 1 and 4 percent.[18] In a 10-m^3 (33-ft) diameter tank, this is about $500 if controlled fittings increase the cost by 4 percent.

Previous responses have discussed the cost effectiveness of controlling fittings and have demonstrated that the cost effectiveness of the revised requirements is reasonable.

Comment: One commenter (IV-D-8) stated that the estimated costs for IFR's are understated. The commenter compared his estimate of $40,000 to install an internal floating roof in a 15-m^3 (49-ft) diameter vessel to the $17,120 assumed in the analysis. The commenter requested that all factors and assumptions used in estimating installed costs be stated.

Another commenter (IV-D-7) requested that EPA reevaluate the cost-effectiveness values for IFR's and EFR's and any regulatory decisions

resulting from them. The commenter's estimates for these values were significantly higher than those made by EPA. The commenter also said that it was not possible to replicate EPA's estimates using the information supplied on estimated installed capital costs of IFR's.

Response: Although the commenter did not provide all of the assumptions used in his cost estimate, it is likely that the $40,000 estimate is based on welded steel deck. As Table 2-8 shows, the commenter's estimate is comparable to the installed costs of welded steel decks that were developed in the Volume I BID. With one exception, the Agency believes that the costs presented in the Volume I BID are reasonable and accurate estimates of the costs to control tanks. Two comments received on the draft CTG stated that the costs used in that document accurately reflected the commenters' actual experience in retrofitting tanks. The costs used in the CTG were developed from the costs presented in Chapter 8 of the Volume I BID. The primary assumption used in the costs is that the vessel is empty, clean, and otherwise ready for the IFR.

One change that has been made in the costs since proposal is in regard to the cost and lifetime of equipping a noncontact deck with a liquid-mounted primary seal. Information received in responses to the CTG indicates that the $2.60/linear meter seal cost had been underestimated. Also, the lifetime of this seal system has been revised downward from 20 years to 10 years. However, the cost effectiveness of BDT is still reasonable. The cost effectiveness of controls will range from about $515/Mg (assuming the product has no value) to net credits (if the product value exceeds $515/Mg) for a model tank with the following parameters[1]:

1. Volume=606 m^3 (160,000 gal);
2. Diameter=9.1 m (30 ft);
3. Vapor pressure=6.9 kPa (1 psia);
4. Molecular weight=80 lb/lb mole; and
5. Turnover rate=50 per year.

These values are reasonable, and no changes have been made to the controls required by § 60.112b as a result of these changes in costs.

The estimates for the emission reduction obtained by fittings should have been 0.894 Mg/yr and not the 0.1 Mg/yr presented in the Volume I

TABLE 2-8. ESTIMATED INSTALLED COST OF A WELDED CONTACT INTERNAL FLOATING ROOF WITH SECONDARY SEAL
(Fourth quarter 1982 dollars)

Tank diameter, m	Roof cost, $[a]
5	15,900
10	30,000
15	44,000
20	58,100
25	72,100
30	86,100

[a]The basic cost of the roof and primary seal is estimated from the equation: cost ($1,000) = 1.91 + 2.54D; where D equals the tank diameter in meters with the correlation coefficient r^2 = 0.883. The additional cost of a secondary seal is estimated based on the factor of $85 per linear meter of circumference. The secondary seal cost is the average price of 13 seals from 8 different vendors.

BID. The cost effectiveness of the revised fitting requirements is presented in Section 2.2.4 of this document.

Comment: One commenter (IV-D-15) said that the costs of lined tanks or pad systems, which are required on many SOCMI tanks, are not represented by the cost estimates, which are based on general tanks holding petroleum liquids.

Response: The cost of tank liners or pad systems for a tank do not affect the costs of controls. These costs are part of the tank, and the tank would be so equipped both with and without the controls. Therefore, these costs are part of both the controlled and uncontrolled case and do not affect the incremental costs of control.

2.6 MISCELLANEOUS

Comment: Two commenters (IV-D-17, IV-D-39) said that it may be difficult for an operator to determine whether or not a vessel is covered by the standards and, if so, what provisions are applicable. The commenters recommended that EPA redraft the proposed standards but provided no specific examples of how to do so. Another commenter (IV-D-5) recommended that EPA supplement the text on these standards with a table summarizing the control requirements by tank size and vapor pressure. The commenter said that this would avoid potential confusion in determining applicability of the standards.

Response: The Agency has determined that the format for determining applicability in the proposed standards is adequate, and no changes have been made to the final standards. Any storage vessel owner/operator with specific questions regarding applicability may contact EPA or the permitting authority.

Comment: Two commenters (IV-D-7, IV-D-8) said that EPA's analysis in the BID is based solely on tanks in the chemical industry and does not reflect tank populations, VOC properties and costs, equipment costs, or control cost effectiveness associated with petroleum liquids.

Response: As stated in several previous responses in this document, the Agency has determined that controlling emissions from petroleum liquid storage vessels is cost effective.

The costs presented in Chapter 8 of the Volume I BID reflect the costs of controls for petroleum liquid storage vessels. Tank population

and the emission reduction obtained by the regulatory alternatives are presented in Appendix D of the Volume I BID. Therefore, it is concluded that BDT is appropriate for petroleum liquid storage vessels, and no changes have been made to the final standards as a result of this comment.

Comment: One commenter (IV-D-15) said that actual emissions from fixed roof storage tanks in the chemical industry, especially padded ones, are overestimated by the emission equations.

Response: In further discussions, the commenter contended that blanketing fixed roof tanks will reduce breathing losses by creating a VOC concentration gradient within the vapor space. The gradient would be created because fresh blanketing gas is drawn from a line at the top of the tank. Thus, the gas expelled during breathing would consist mainly of blanketing gas. The commenter also contended that the same principle will slightly reduce fixed roof tank working losses.[28]

The situation described by the commenter does not differ from unblanketed fixed roof tanks. Such tanks draw fresh air through a vent in the top of the tank and expel a VOC/air mixture later. The current breathing loss equations do not assume saturation of the vapor space inside the tank, thereby allowing for the VOC concentration gradient described by the commenter. Therefore, the Agency believes that the emission equations used in the BID adequately account for the case described by the commenter.

Even if the commenter is correct and blanketing reduces fixed roof tank breathing losses, the losses account for only about 14 percent of total losses for a typical fixed roof tank in the chemical industry. Therefore, even in the most extreme case, the theoretical situation described by the commenter would not affect the selection of BDT for these tanks.

Comment: One commenter (IV-D-4) suggested that numbers be rounded in the proposed standards. Three commenters (IV-D-5, IV-D-9, IV-D-39) requested that English unit equivalents be shown in parentheses in the proposed standards.

Response: Numbers have been rounded in the final standards where appropriate. However, in cases where rounding would undermine historical precedents for control cutoffs, values have been retained as written.

English unit equivalents have been included for the industry's convenience in the Preamble to the final standards. English unit equivalents have not been added to the regulation, however. Such a revision, because of conversion factors, would modify the control cutoffs and, in some cases, would make the cutoffs more stringent than those originally proposed. This would result in the need to repropose cutoffs and would be counterproductive to a timely promulgation of the standards.

Comment: One commenter (IV-D-7) noted a typographical error in § 60.111b(f). The commenter said that "nonvolatile" should be changed to "volatile."

Response: The commenter was correct in noting a typographical error in what was originally § 60.111b(f). The correction has been made in the final standards. This section is now §60.111b(g).

Comment: One commenter (IV-D-7) requested that the proposed standards include definitions that are found in the preamble for terms such as "VOC" and "petroleum liquid."

Response: The term "VOC" has been defined in § 60.2 of the General Provisions of the Clean Air Act. However, the term "petroleum liquids" has been defined in the final standards in § 60.111b(i).

Comment: One commenter (IV-D-7) suggested that floating roof fittings be defined per page 22 of API Bulletin No. 2519. The commenter said that this will avoid inconsistency with API Bulletin No. 2519 and recognize that an automatic bleeder vent is the same as a vacuum breaker.

Response: The commenter was correct in noting inconsistency in the floating roof fitting definition. The Agency recognizes that automatic bleeder vents are the same as vacuum breaker vents, and the correction has been made in the final standards.

Comment: One commenter (IV-D-7) had the following comments on § 60.112b(a)(1) and (2):

1. The section should distinguish between contact and noncontact roofs. The commenter also said that deck penetration on contact roofs in IFR's and EFR's should not extend into the liquid as is required in these sections for all floating decks regardless of type.

2. The wording "except for contact decks" should be added to § 60.112b(a)(1)(iii) to make §§ 60.112b(a)(1) and (2) consistent throughout.

3. The wording "column wells" should be deleted in § 60.112b(a)(1)(iv) and "leg sleeves" should be added for completeness.

4. Section 60.112b(a)(1)(v) should be revised to read ". . . at all times when the roof is floating, except when the roof is being floated off or landed on the roof by supports. . . ." for correctness and consistency with proposed § 60.112b(a)(2)(ii).

5. The word "form" should be changed to "foam" in the fourth line of § 60.112b(a)(2)(i)(A).

Response: The requirement that deck penetrations on contact decks extend to the liquid has been deleted. The Agency recognizes that this requirement is not necessary because there is no vapor space under the deck, and all related changes have been made in the final standards. The relevant typographical errors noted by the commenter have been changed in the final standards.

Comment: One commenter (IV-D-13) said that if there is no reason not to allow the use of control options defined in §§ 60.112b(a)(1), (2), and (3) for tanks storing high vapor pressure liquids defined in § 60.112(b), § 60.112b(a) can be rewritten as follows:

"The owner or operator of each storage vessel with a design capacity greater than or equal to 151 m^3 containing VOL that, as stored, has a maximum true vapor pressure equal to or greater than 3.5 kPa or a design capacity greater than or equal to 75 m^3 but less than 151 m^3 containing VOL that, as stored, has a maximum true vapor pressure equal to or greater than 27.5 kPa, shall equip each storage vessel with one of the following . . ." and § 60.112b(b) can then be deleted.

Response: The modification suggested by the commenter is not equivalent in meaning to the original language. The suggested wording would delete the control requirement for pressure vessels equipped with closed vent systems and for control devices storing high vapor pressure liquids (76.6 kPa [11.1 psia] or greater). Therefore, the Agency has not revised the standards according to the commenter's suggestion.

Comment: One commenter (IV-D-4) suggested that "external floating roof" be defined in § 60.111b rather than in § 60.112b(a)(2).

Response: The definitions in § 60.111b are general in nature and apply to the subpart as a whole. The term "external floating roof" is best described in the section (§ 60.112b(a)(2)) describing control techniques, and no changes have been made in the final standards.

Comment: One commenter (IV-D-7) made several minor editorial comments on the Volume I BID.

Response: None of the changes suggested by the commenter will have any impact on the selection or form of the final standards. Therefore, the Volume I BID is considered a final document, and no changes have been made.

Comment: One commenter (IV-D-39) stated that the standards are unfair to the owner or operator of a new vessel constructed after the date of proposal but prior to the date of promulgation.

Response: In passing the Clean Air Act, Congress gave as one of the purposes of the Act the protection and enhancement of the "quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population" (Section 101(b)(2)). Therefore, in order to provide the maximum benefit from the regulations, the Congress provided that the date regulations are proposed is the date they become applicable to new sources (Section 111(a)(2)).

2.7 REFERENCES FOR CHAPTER 2

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18. Research Triangle Institute. Petroleum Liquid Storage Tank NSPS: Economic Impacts on Bulk Gasoline Plants. May 1985. 19 p.

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